GATE 2022 General Aptitude (GA)

Q.1 – Q.5 Carry ONE mark each.

Q.1	Inhaling the smoke from a burning _____ could _____ you quickly.
(A)	tire / tier
(B)	tire / tyre
(C)	tyre / tire
(D)	tyre / tier

Q.2	A sphere of radius r cm is packed in a box of cubical shape. What should be the minimum volume (in cm^3) of the box that can enclose the sphere?
(A)	$\dfrac{r^3}{8}$
(B)	r^3
(C)	$2r^3$
(D)	$8r^3$

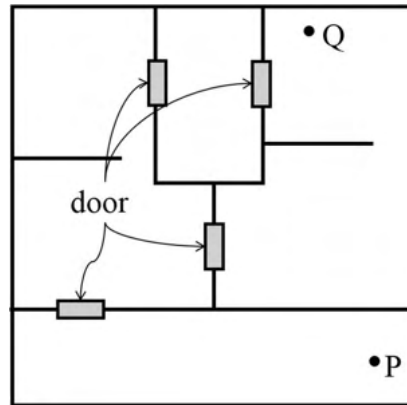| Q.3	Pipes P and Q can fill a storage tank in full with water in 10 and 6 minutes, respectively. Pipe R draws the water out from the storage tank at a rate of 34 litres per minute. P, Q and R operate at a constant rate.
	If it takes one hour to completely empty a full storage tank with all the pipes operating simultaneously, what is the capacity of the storage tank (in litres)?
(A)	26.8
(B)	60.0
(C)	120.0
(D)	127.5

Q.4	Six persons P, Q, R, S, T and U are sitting around a circular table facing the center not necessarily in the same order. Consider the following statements:
	• P sits next to S and T.
	• Q sits diametrically opposite to P.
	• The shortest distance between S and R is equal to the shortest distance between T and U.
	Based on the above statements, Q is a neighbor of
(A)	U and S
(B)	R and T
(C)	R and U
(D)	P and S

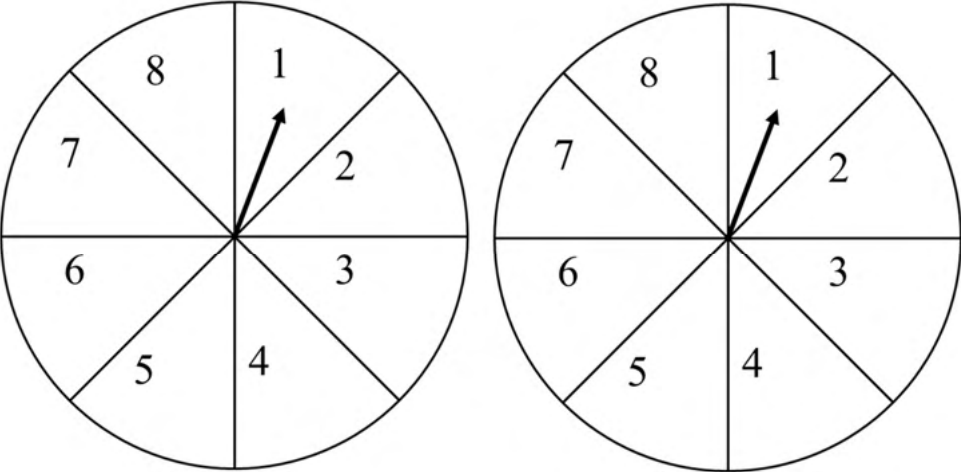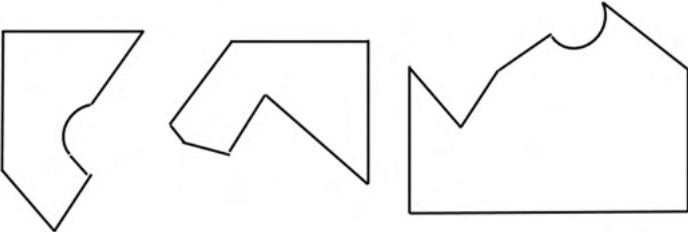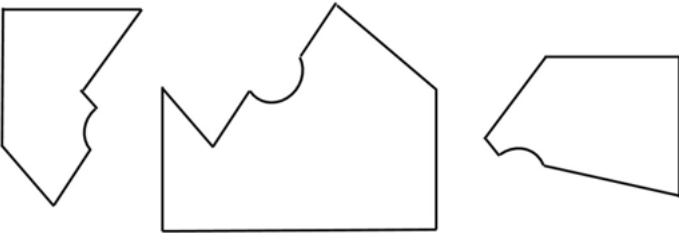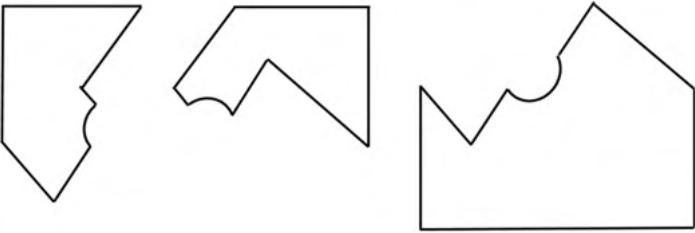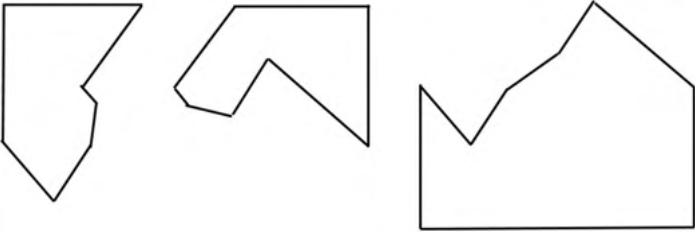| Q.5	A building has several rooms and doors as shown in the top view of the building given below. The doors are closed initially. What is the minimum number of doors that need to be opened in order to go from the point P to the point Q?
(A)	4
(B)	3
(C)	2
(D)	1

Q. 6 – Q. 10 Carry TWO marks each.

Q.6	Rice, a versatile and inexpensive source of carbohydrate, is a critical component of diet worldwide. Climate change, causing extreme weather, poses a threat to sustained availability of rice. Scientists are working on developing Green Super Rice (GSR), which is resilient under extreme weather conditions yet gives higher yields sustainably.
	Which one of the following is the CORRECT logical inference based on the information given in the above passage?
(A)	GSR is an alternative to regular rice, but it grows only in an extreme weather
(B)	GSR may be used in future in response to adverse effects of climate change
(C)	GSR grows in an extreme weather, but the quantity of produce is lesser than regular rice
(D)	Regular rice will continue to provide good yields even in extreme weather

Q.7	A game consists of spinning an arrow around a stationary disk as shown below. When the arrow comes to rest, there are eight equally likely outcomes. It could come to rest in any one of the sectors numbered 1, 2, 3, 4, 5, 6, 7 or 8 as shown.
	Two such disks are used in a game where their arrows are independently spun.
	What is the probability that the sum of the numbers on the resulting sectors upon spinning the two disks is equal to 8 after the arrows come to rest?
(A)	$\dfrac{1}{16}$
(B)	$\dfrac{5}{64}$
(C)	$\dfrac{3}{32}$
(D)	$\dfrac{7}{64}$

Q.8	Consider the following inequalities. (i) $3p - q < 4$ (ii) $3q - p < 12$ Which one of the following expressions below satisfies the above two inequalities?
(A)	$p + q < 8$
(B)	$p + q = 8$
(C)	$8 \leq p + q < 16$
(D)	$p + q \geq 16$

Q.9	Given below are three statements and four conclusions drawn based on the statements.
	Statement 1: Some engineers are writers.
	Statement 2: No writer is an actor.
	Statement 3: All actors are engineers.
	Conclusion I: Some writers are engineers.
	Conclusion II: All engineers are actors.
	Conclusion III: No actor is a writer.
	Conclusion IV: Some actors are writers.
	Which one of the following options can be logically inferred?
(A)	Only conclusion I is correct
(B)	Only conclusion II and conclusion III are correct
(C)	Only conclusion I and conclusion III are correct
(D)	Either conclusion III or conclusion IV is correct

Q.10	Which one of the following sets of pieces can be assembled to form a square with a single round hole near the center? Pieces cannot overlap.
(A)	
(B)	
(C)	
(D)	

Q.11 – Q.35 Carry ONE mark Each

Q.11   The number of solution(s) of the system of linear equations

$$\begin{aligned} x + \ y + z \ &= 0 \\ x - \ y + z \ &= 0 \\ x + 2y - z \ &= 0 \end{aligned}$$

is

(A)   1

(B)   0

(C)   Infinite

(D)   More than one but finite

Q.12 $\lim\limits_{x \to 0} \dfrac{e^x - 1}{x^2}$ is equal to

(A)   1

(B)   0

(C) $\dfrac{1}{2}$

(D)   2

Q.13   An integrating factor of the differential equation

$$xdy + (1 - y)dx = 0$$

is

(A) $\dfrac{1}{x}$

(B) x

(C) e^x

(D) $\dfrac{1}{x^2}$

Q.14   Cotton fibre has maximum amount of cellulose in

(A)   Cuticle

(B)   Primary cell wall

(C)   Secondary cell wall

(D)   Lumen

Q.15   High extensibility of wool fibre is due to

(A)   Presence of scales

(B) α-helix structure of proteins

(C)   Cross-linking

(D) β-sheet structure of proteins

Q.16   In a comber, the component that rotates both in the forward and backward directions is

(A)   Nipper

(B)   Top comb

(C)   Cylinder comb

(D)   Detaching roller

Q.17   Yarn that has helically twisted fibres at the core and belts/wrappers on the surface is

(A)   Ring yarn

(B)   Rotor yarn

(C)   Compact yarn

(D)   Air-vortex yarn

Q.18   The ingredient that is **NOT** used in sizing formulations is

(A)   Starch

(B)   Polyvinyl acetate

(C)   Polyvinyl alcohol

(D)   Polycarbonate

Q.19 The machine that uses 'Horn gears' is

(A) Warp knitting

(B) Circular braiding

(C) Sectional warping

(D) Shuttle loom

Q.20 Direct measurement of degree of thickening (θ) of cotton fibre is carried out using

(A) AFIS

(B) HVI

(C) Caustic soda method

(D) Double compression method

Q.21   A relatively flat middle zone in a comb sorter diagram indicates

(A)   Higher fibre length variation

(B)   Lower fibre length variation

(C)   Higher mean length

(D)   Lower mean length

Q.22   Scouring and cold mercerisation of cotton are carried out by treatment with aqueous sodium hydroxide. The process parameters that differ in the two processes are

(A)   Temperature and alkali concentration only

(B)   Temperature and treatment time only

(C)   Treatment time and alkali concentration only

(D)   Temperature, treatment time and alkali concentration

Q.23   Woven fabrics can be dyed in open width form in

(A)   Jigger and winch

(B)   Jigger and jet dyeing machine

(C)   Winch and beam dyeing machine

(D)   Jigger and beam dyeing machine

Q.24   The determinant of a 3×3 matrix A is 30. If 2 and 3 are two Eigenvalues of A, then the third Eigenvalue of A (*in integer*) is _____.

Q.25   A fair coin is tossed five times. The probability of obtaining at most two "HEAD" (*correct up to 1 decimal place*) is _____.

Q.26   Molecular weight (g/mol) of polypropylene with a degree of polymerisation of 1000 (*rounded off to nearest integer*) is _____.

Q.27   Polydispersity index of a polymer is 5 and its weight average molecular weight is 8400 g/mol. The number average molecular weight (g/mol) of the polymer (*in integer*) is _____.

Q.28   A three-bladed beater is running with an angular velocity of 600 rpm and delivering material at a rate of 600 kg/h. Number of strikes per kg of delivered material (*in integer*) is _____.

Q.29   Assume that there is no compression of roving during winding and each coil of a layer is placed directly over the coil of the previous layer. A full roving bobbin consisting of 50 layers of roving is wound on an empty bobbin of 60 mm diameter. If the diameter of the roving is 1 mm, then the diameter (mm) of the full bobbin (*in integer*) is _____.

Q.30   A yarn is unravelled from a woven fabric specimen of 1 m × 1 m size. If the length of the straightened yarn is 1.1 m, then the crimp percentage (*in integer*) is _____.

Q.31   In a projectile loom, the energy stored in a torsion rod just before picking is proportional to r^n. If r is the radius of torsion rod, then the value of n (*in integer*) is _____.

Q.32   Cusick drape test on a fabric specimen results in a drape coefficient of 0.7. If the total mass of the paper ring is 3.0 g, then the mass (g) of the paper with shadowed area (*correct up to 1 decimal place*) is _____.

Q.33   If moisture regain of polyester and cotton is 0.4 % and 8.5 %, respectively, then moisture regain (%) of 70:30 polyester-cotton blend (*correct up to 2 decimal places*) is _____.

Q.34   A pad bath for flame retardant finishing is prepared by mixing 300 g/L diammonium phosphate (DAP) aqueous solution with 60 g/L softener solution in the ratio of 2:1 (v/v). The concentration (g/L) of DAP in the resultant solution (*in integer*) is _____.

Q.35   If the reflectance of a dyed fabric at λ_{max} is 10 %, then the colour strength value (K/S) of the dyed fabric (*correct up to 2 decimal places*) is _____.

Q.36 – Q.65 Carry TWO marks Each

Q.36   If the probability density function of a continuous random variable X is given by

$$f(x) = \begin{cases} (x-2)a, & 2 \le x \le 4 \\ (8-x)a, & 4 < x \le 8 \\ 0, & \text{otherwise,} \end{cases}$$ where a is a constant

then the value of a is

(A)   0.2

(B)   0.1

(C)   0.5

(D)   0.4

Q.37   Let $f: R^2 \to R$ (R is the set of real numbers) be defined by

$$f(x, y) = \begin{cases} \dfrac{(x-y)^3}{x^2+y^2}, & (x, y) \neq (0,0) \\ \qquad 0, & (x, y) = (0,0) \end{cases}.$$

If $f_x(0,0)$ and $f_y(0,0)$ denote partial derivatives of f with respect to x and y at the point $(0,0)$, respectively, then $f_x(0,0)$ and $f_y(0,0)$, respectively, are

(A)   1 and 1

(B)   1 and 2

(C)   1 and -1

(D)   2 and 1

Q.38   Match the properties listed in Group I with the corresponding measuring techniques given in Group II. The correct option is

Group I	Group II
P. Crystallinity	1. TGA
Q. Thermal stability	2. Birefringence
R. Surface morphology	3. WAXD
S. Orientation	4. SEM

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

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

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

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

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

[a]: In viscose rayon manufacturing process, the fibres develop a skin-core structure.

[r]: During extrusion, the polymer molecules near the wall of the spinneret tend to orient less as compared to molecules at the centre of the fibre.

(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   Determine the correctness or otherwise of the following Assertion [a] and Reason [r].

[a]: Para-aramid fibres have better mechanical properties as compared to meta-aramid fibres

[r]: The chemical structure of para-aramid fibres allows them to pack closely

(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.41   Keeping the speed of all other components of a carding machine unchanged, the angular velocity of a cylinder with damaged wire points in an area of 2 cm × 2 cm is doubled. Wavelength of the periodic fault in the card sliver would be

(A)   Same

(B)   Halved

(C)   Doubled

(D)   Tripled

Q.42   Determine the correctness or otherwise of the following Assertion [a] and Reason [r].

[a]: As compared to parallel wound yarn packages, ring bobbins exhibit lower tendency of slough off during unwinding

[r]: The main winding layers in the ring bobbins are separated by cross-winding layers

(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.43   A set of yarns is produced with same linear density. If these yarns follow helical model and their diameter is inversely proportional to twist (number of turns per unit length), then the yarns have the same

(A)   Packing density

(B)   Twist multiplier

(C)   Twist angle of surface fibres

(D)   Area of cross-section

Q.44   Consider the following statements for a shuttle loom having linear (straight line) displacement profile for the picker:

P. The maximum actual acceleration of shuttle depends on loom speed and alacrity of picking system

Q. The maximum actual velocity of shuttle depends on loom speed

R. The maximum actual acceleration and maximum actual velocity of shuttle occur at the same time

S. Nominal displacement of shuttle is inversely proportional to the angular movement of crank shaft

The combination of TRUE statements is

(A)   P and Q

(B)   Q and R

(C)   R and S

(D)   P and R

Q.45   Eight-end regular sateen fabric can be woven with move (step) numbers of

(A)   2 or 8

(B)   1 or 7

(C)   3 or 5

(D)   4 or 6

Q.46   Consider the following components of a needle:

P. Shank

Q. Beard

R. Barb

S. Latch

The combination of correct components of a needle in a needle punching nonwoven machine is
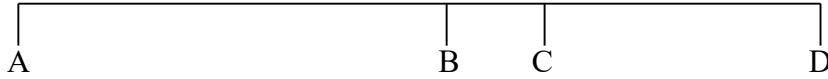
(A)   P and Q

(B)   Q and R

(C)   R and S

(D)   P and R

Q.47 The schematic of elastic recovery of a textile material is given below

Where

AB = original length; BD = total extension; CD = elastic extension;

BC = permanent set

With reference to the above schematic, consider the following statements:

P. For perfectly elastic material, BC = 0

Q. For perfectly elastic material, CD = 0

R. For perfectly plastic material, BC = 0

S. For perfectly plastic material, CD = 0

The combination of TRUE statements is

(A)   P and Q

(B)   Q and R

(C)   R and S

(D)   P and S

Q.48 Consider the following statements with reference to testing of cotton fibre in HVI:

P. Strength is measured in single fibre form

Q. Strength is measured in fibre bundle form

R. Fineness is measured by air flow method

S. Fineness is determined by measuring fibre diameter

The combination of TRUE statements is

(A) P and Q

(B) Q and R

(C) R and S

(D) P and R

Q.49   Determine the correctness or otherwise of the following Assertion [a] and Reason [r].

[a]: In crease resistant finishing process of cotton with DMDHEU, curing is not carried out in steam

[r]: Steam causes DMDHEU to self-polymerise rather than crosslink cotton

(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.50   Consider the following statements with respect to a cotton fabric which has been fully desized and bleached but not scoured:

P. It has residual seed coat fragments

Q. It has poor water absorbency

R. It has high whiteness index

S. It has high crease recovery

The combination of TRUE statements is

(A)   P, Q and R

(B)   Q, R and S

(C)   P, R and S

(D)   P, Q and S

Q.51   In a dye identification test, a dyed fabric is immersed in an aqueous alkaline solution of a reducing agent. The colour of the dyed fabric changes and some dye bleeds out in the solution. The correct combination of the fabric and dye is

(A)   Wool and acid dye

(B)   Polyester and disperse dye

(C)   Cotton and vat dye

(D)   Acrylic and basic dye

Q.52   Assuming the step size h = 1, the numeric value (rounded off to 2 decimal places) of the definite integral

$$\int_1^3 \frac{x}{1+x}\, dx$$

obtained using Simpson's rule is _____.

Q.53   Let y' and y'' denote the first and second order derivatives of y with respect to x, respectively. Let $y(x)$ be a solution of the initial value problem:

$$y'' - 3y' + 2y = 0, \qquad y(0) = 1, \qquad y'(0) = 3.$$
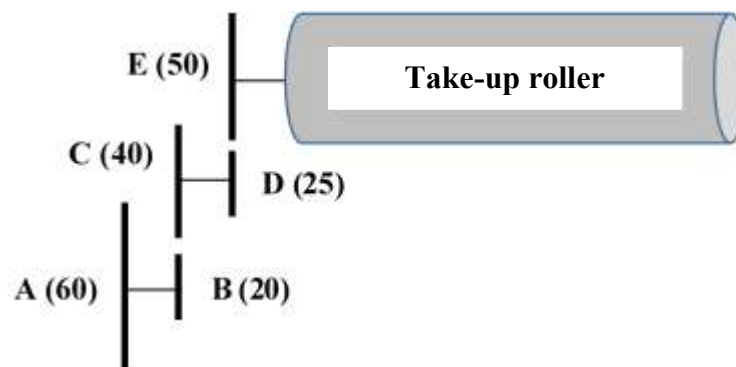
Then $y''(0)$ (*in integer*) is _____.

Q.54   The Gibb's free energy equation for a system undergoing phase transition is given by $\Delta G = \Delta H - T\Delta S$, where ΔG is the change in Gibb's free energy, ΔH is the change in enthalpy, ΔS is the change in entropy and T is the temperature in Kelvin.

During melting transition, two systems A and B, show no difference in ΔH but B exhibits 10 % lower ΔS than A. The ratio of melting temperature of B to that of A (*rounded off to 2 decimal places*) is _____.

Q.55   A monofilament gets extruded at a speed of 10 m/min from a spinneret of 0.2 mm diameter. In order to ensure a spin draw ratio of 11, the first godet roller with a diameter of 70 cm has to rotate with an angular velocity (rpm) of (*rounded off to nearest integer*) _____.

Q.56 Nine slivers having same mean linear density are doubled on a drawframe. If the standard deviation of linear density of each sliver is 0.3 ktex, then the standard deviation (ktex) of linear density of the doubled sliver (*correct up to 1 decimal place*) is _____.

Q.57 The twist angle (degree) of surface fibres in a yarn with density of 700 kg/m^3 and twist multiplier of 6000 m^{-1}·tex$^{0.5}$ (*rounded off to nearest integer*), is _____.

Q.58 In a multiplicative type tensioner, the angle of wrap is 90° and the coefficient of friction between the yarn and the guide is 0.2. If the input yarn tension is 10 cN, then the output yarn tension (cN) is (*rounded off to 1 decimal place*) _____.

Q.59 A take-up motion is shown below. The number of teeth on gear A, B, C, D and E are 60, 20, 40, 25 and 50, respectively. The circumference of the take-up roller is 40 cm. If one tooth is broken on gear B, then the wavelength (cm) of the fault in fabric (*in integer*) is _____.
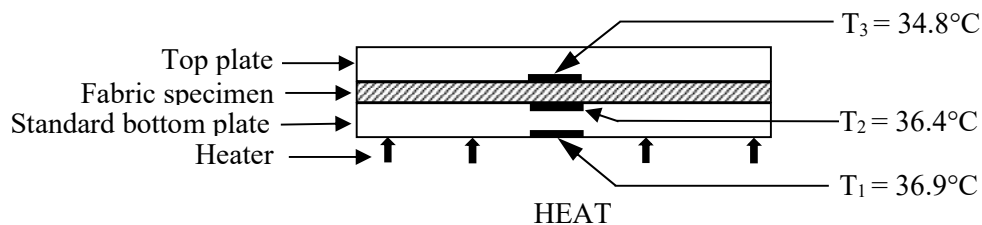
Q.60 The tensile load (F) in Newton (N) and the elongation (ε) in cm of a yarn are related as follows

$$F = 2\varepsilon^2 + \varepsilon$$

If the breaking elongation of the yarn is 10 cm, then the work of rupture (N·m) of yarn (*rounded off to 2 decimal places*) is _____.

Q.61 Under steady-state thermal conditions, the temperature at various locations in a two-plate Togmeter is as shown in the Figure given below. If the thermal resistance of the standard bottom plate is 1.5 K/W, then the thermal resistance (K/W) of fabric specimen (*correct up to 1 decimal place*) is _____.

Togmeter: Two plate method

Q.62 For a wool fibre strand, the relationship between V_r (limit CV % of linear density) and N (average number of fibres in the cross-section of the strand) is given below.

$$V_r = \frac{112}{\sqrt{N}}$$

For the above relationship, the CV % of linear density of wool fibre (*rounded off to 2 decimal places*) is _____.

Q.63 The breaking load of a cotton yarn, with a twist multiplier of 4 tpi·Ne$^{-0.5}$, is 2.5 N. If the twist (number of turns per inch) of yarn is 20, then the tenacity (cN/tex) of the yarn (*rounded off to 2 decimal places*) is _____.

Q.64   A cotton fabric is dyed at 5 % shade (owf) using a monofunctional reactive dye. The molecular weight of the dye and cellobiose unit is 400 and 342, respectively. If all the hydroxyl groups in cellulose are accessible for reaction, the percentage of unreacted hydroxyl groups of cellulose remaining after dyeing (*rounded off to 2 decimal places*) is _____.

Q.65   A polyester fabric of 150 cm width and areal density of 300 g/m^2 is printed at a speed of 60 m/min. The solid content of the print paste is 50 %. After printing and drying, the areal density of the printed fabric becomes 400 g/m^2. The consumption (kg/h) of the print paste (*in integer*) is _____.