GENERAL APTITUDE

1.

Items	Cost (Rs)	Profit %	Marked Price
P	5, 4000	…	5,860
Q	…	25	10,000

Details of prices of two items P and Q are presented in the above table. The ratio of cost item P to cost of item Q is 3:4. Discount is calculated as the difference between the marked price and the selling price. The profit percentage is calculated as the ratio of the difference between selling price and cost, to the cost

$$\left(\text{Profit }\% = \frac{\text{Selling price} - \text{Cost}}{\text{Cost}} \times 100\right)$$

The discount on item Q, as a percentage of its marked price, is ______________

(A) 25 (B) 10 (C) 12.5 (D) 5

Key: (B)

Sol: Given: Ratio of cost of item P to cost of item Q = 3 : 4

Cost of item P = 5400

Cost of item Q = 7200

Profit % on item Q = 25

$\therefore$ Selling price of item Q = $7200 \times \frac{125}{100} = 9000$

$\therefore$ Discount of item Q = Marked price – selling price

$= 10{,}000 - 9000 = 1000$

$\therefore$ Discount % $= \frac{1000}{10{,}000} \times 100 = 10$

2. Given below are two statements 1 and 2, and two conclusions I and II.

Statement 1: All bacteria are microorganisms.

Statement 2: All pathogens are microorganisms.

Conclusion I: Some pathogens are bacteria.

Conclusion II: All pathogens are not bacteria.

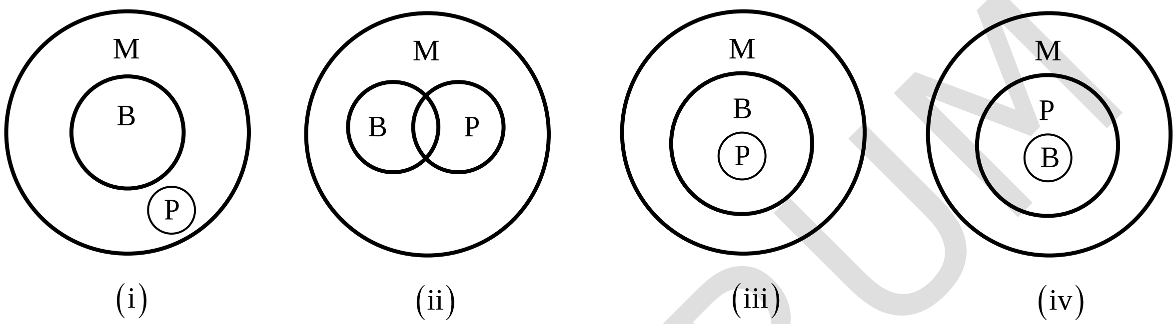
Based on the above statements and conclusions, which one of the following options is logically CORRECT?

(A) Only conclusion II is correct (B) Either conclusion I or II is correct

(C) Neither conclusion I or II is correct (D) Only conclusion I is correct

Key: (C)

Sol: Using Venn diagrams, the different possibilities are



From figure (i), conclusion I is incorrect

From figure (ii), conclusion II is incorrect

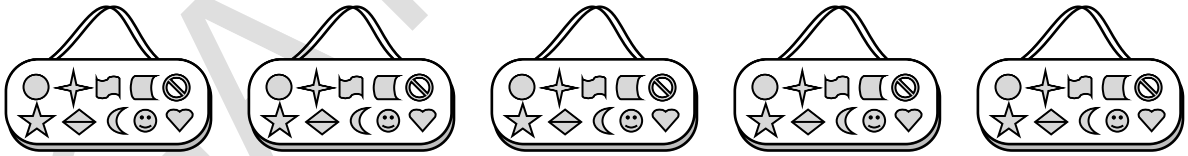
Hence, neither conclusion I nor II is correct

3. There are five bags each containing identical sets of ten distinct chocolates. One chocolate is picked from each bag.

(A) 0.6979 (B) 0.3024 (C) 0.8125 (D) 0.4235

Key: (A)

Sol:



Total number of cases in sample space $= 10\times10\times10\times10\times10 = 10^5$

Event A $\rightarrow$ At least two chocolates are identical

Probability of A, ie., $P\begin{pmatrix}\text{atleast two are} \\ \text{identical}\end{pmatrix} = 1 - P(\text{alldifferent})$

$$\Rightarrow P(A) = 1 - \frac{10\times9\times8\times7\times6}{10^5} = 1 - 0.3024 = 0.6976$$

4. Consider the following sentences:

(i) Everybody in the class is prepared for the exam.

(ii) Babu invited Danish to his home because he enjoys playing chesss.

Which of the following is the CORRECT observation about the above two sentences?

(A) (i) is grammatically incorrect and (ii) is unambiguous

(B) (i) is grammatically correct and (ii) is unambiguous

(C) (i) is grammatically correct and (ii) is ambiguous

(D) (i) is grammatically incorrect and (ii) is ambiguous

Key: (C)

Sol: (i) is grammatically correct and

(ii) is ambiguous.

Statement 2 is ambiguous because we do not know who enjoys playing chess, Babu or Danish !!

Statement 1 is grammatically correct.

5. The ratio of boys to girls in a class is 7 to**3.**

Among the options below, an acceptable value for the total number of students in the class is:

(A) 21 (B) 73 (C) 37 (D) 50

Key: (D)

Sol: Given: Ratio of boys to girls

∴ Multiples of 10 are : 10, 20, 30, 40, 50, 60, 70,.........

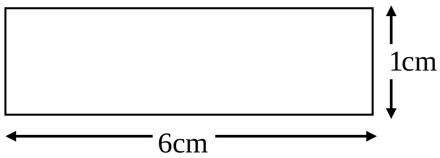
∴ An acceptable value for the total number of students is 50.

6. We have 2 rectangular sheets of paper, M and N, of dimension 6 cm × 1 cm each. Sheet M is rolled to form an open cylinder by bringing the short edges of the sheet together. Sheet N is cut into equal square patches and assembled to form the largest possible closed cube. Assuming the ends of the cylinder are closed, the ratio of the volume of the cylinder to that of the cube is ___________.

(A) 3π (B) $\frac{9}{\pi}$ (C) $\frac{3}{\pi}$ (D) $\frac{\pi}{2}$

Key: (B)

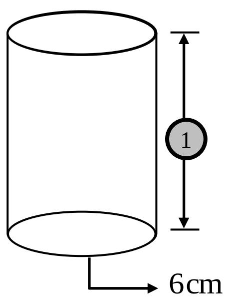
Sol: Given:

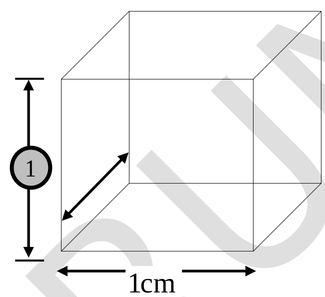


Sheet M

Sheet N

$\Downarrow$ $\Downarrow$





$\Downarrow$ $\Downarrow$

Volume of cylinder

$V = \pi r^2 h;$

where $h = 1$, r is maximum

But $2\pi r = 6\text{cm}$

$\Rightarrow r^2 = \frac{6}{2\pi} = \frac{3}{\pi}$

$\therefore V = \pi\left(\frac{3}{\pi}\right)^2 (1) \;\; \Rightarrow V = \frac{9}{\pi}\text{cm}^3$

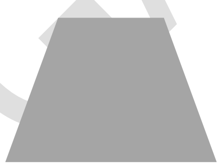
Volume of unit cube $= 1\text{cm}$

Required ratio $= \dfrac{\frac{9}{\pi}}{(1)} = \frac{9}{\pi}$

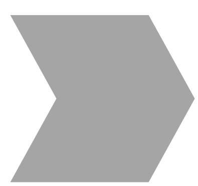
7. A polygon is convex if, for every pair of points, P and Q belonging to the polygon, the line segment PQ lies completely inside or on the polygon.

Which one of the following is NOT a convex polygon?

(A)

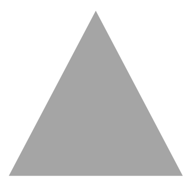


(B)



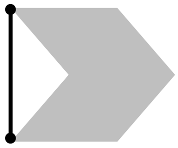
(C)

(D)



Key: (B)

Sol:



Here line segment does not lie inside of on the polygon.

Hence the figure in option (B) is not a convex polygon

8. ________ is to surgery as writer is to _________.

Which one of the following options maintains a similar logical relation in the above sentence?

(A) Doctor, book

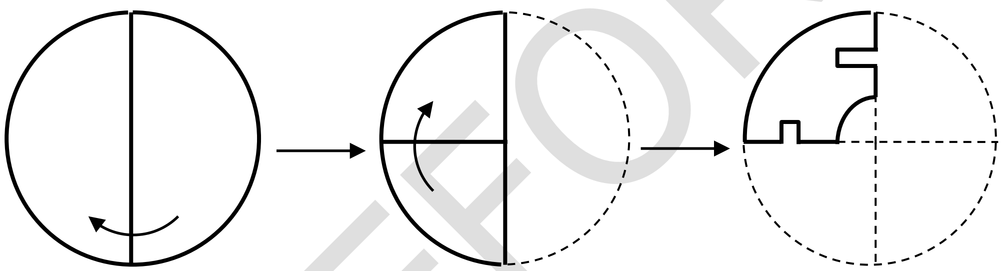
(B) Plan, outline

(C) Medicine, grammar

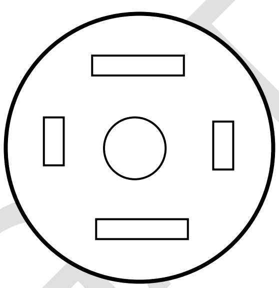
(D) Hospital, library

Key: (A)

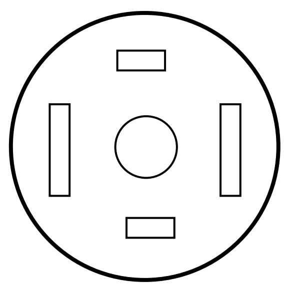
9. A circular sheet of paper is folded along the lines in the directions shown. The paper, after being punched in the final folded state as shown and unfolded in the reverse order of folding, will look like



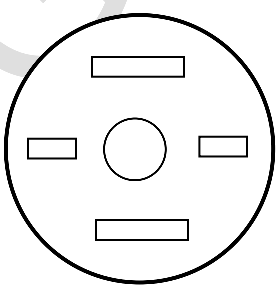
(A)



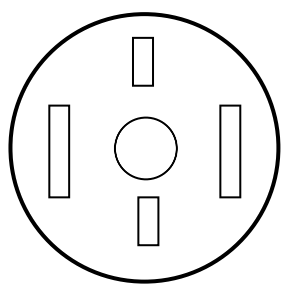
(B)



(C)



(D)



Key: (A)

10. Some people suggest anti-obesity measures (AOM) such as displaying calorie information in restaurant menus, such measures sidestep addressing the core problem that cause obesity: poverty and income inequality.

Which one of the following statements summarizes the passage?

(A) AOM are addressing the core problems and are likely to succeed

(B) If obesity reduces, poverty will naturally reduce, since obesity causes poverty

(C) The proposed AOM addresses the core problems that cause obesity

(D) AOM are addressing the problem superficially

Key: (D)

Sol: As AOM are not addressing the core problems, they are superficial.

Superficial: shallow, cursory mean lacking in depth or solidity. superficial implies a concern only with surface aspects or obvious features. a superficial analysis of the problem shallow is more generally derogatory in implying lack of depth in knowledge, reasoning, emotions, or character.

TEXTILE ENGINEERING

1. Let the function f(x, y) be define as

$$f(x,y)=\begin{cases}\frac{y}{|y|}\sqrt{2x^2+3y^2}, & y\neq 0\\ 0, & y=0\end{cases}$$

Then $\frac{\partial f}{\partial y}(0,0)$ is equal to

(A) $\sqrt{2}$ (B) $\sqrt{3}$ (C) 0 (D) 1

Key: (B)

Sol: $\frac{\partial f}{\partial y}(0,0)=\lim_{y\to 0} f(0,y)-f(0,0)$

$$=\lim_{y\to 0}\left[\frac{\left(\frac{y}{|y|}\sqrt{2(0)+3y^2}\right)-0}{y}\right]$$

$$=\lim_{y\to 0}\frac{\sqrt{3}|y|}{|y|}\qquad \left(\because \sqrt{y^2}=|y|\right)$$

$$=\lim_{y\to 0}\left(\sqrt{3}\right)=\sqrt{3},\qquad \text{Option (B)}$$

(Since at (0, 0), $\frac{\partial f}{\partial y}=\lim_{y\to 0}\frac{f(0,y)-f(0,0)}{y}$ and $y\to 0$ means $y\neq 0$)

2. If a continuous random variable X has the following probability density function

$$g(x)=\begin{cases}\frac{k}{4}x(2-x), & 0<x<2\\ 0, & \text{otherwise}\end{cases}$$

Then the value of k is

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

Key: (C)

Sol: Since g(x) is p.d.f

$$\therefore \int_x g(x)dx=1\Rightarrow \int_0^2 \frac{k}{4}x(2-x)dx=1$$

$$\Rightarrow \frac{k}{4}\int_0^2 \left(2x - x^2\right)dx = 1 \Rightarrow \frac{k}{4}\left[x^2 - \frac{x^3}{3}\right]_0^2 = 1$$

$$\Rightarrow \frac{k}{4}\left[4 - \frac{8}{3}\right] = 1 \Rightarrow k = 3, \text{ option (B)}$$

3. The smallest positive real number λ, for which the following problem

$$y''(x) + \lambda y(x) = 0,$$
$$y'(0) = 0,\ y(1) = 0$$

Has non-zero solution, is

(A) π^2 (B) $\frac{\pi^2}{2}$ (C) $\frac{\pi^2}{4}$ (D) $\frac{\pi^2}{8}$

Key: **(C)**

Sol: $\left(D^2 + \lambda\right)y = 0$ is the given D.E, $D = \frac{d}{dx}$

A.E is $m^2 + \lambda = 0 \Rightarrow m^2 = -\lambda \Rightarrow m = \pm\sqrt{\lambda}\, i$

$$\alpha \pm i\beta \Rightarrow \alpha = 0, \beta = \sqrt{\lambda}$$

$\therefore$ General solution is $y = C.F$

$$\Rightarrow y = e^{0x}\left[c_1 \cos\left(\sqrt{\lambda}x\right) + c_2 \sin\left(\sqrt{\lambda}x\right)\right]$$

$$y(x) = c_1 \cos\left(\sqrt{\lambda}x\right) + c_2 \sin\left(\sqrt{\lambda}x\right) \quad \ldots(1)$$

$$\Rightarrow y'(x) = -\sqrt{\lambda}c_1 \sin\left(\sqrt{\lambda}x\right) + \sqrt{\lambda}.c_2 \cos\left(\sqrt{\lambda}x\right) \quad \ldots(2)$$

Using $y(1) = 0$ and $y'(0)$, (1) and (2) gives

$$0 = c_1 \cos\left(\sqrt{\lambda}\right) + c_2 \sin\left(\sqrt{\lambda}\right) \quad \ldots(3)$$

$$0 = \sqrt{\lambda}c_2 \Rightarrow c_2 = 0$$

$$\therefore (3) \Rightarrow c_1 \cos\left(\sqrt{\lambda}\right) = 0$$

Since, $c_1 \neq 0$ (If $c_1 = 0$ then $(1) \Rightarrow y = 0$, a zero solution)

$$\therefore \cos\left(\sqrt{\lambda}\right) = 0$$

$$\Rightarrow \sqrt{\lambda} = \frac{\pi}{2} \text{ or } \frac{3\pi}{2} \text{ or } \frac{5\pi}{2} \ldots.$$

Smallest positive for $\sqrt{\lambda}$

$\therefore \lambda = \frac{\pi^2}{4}$ is the smallest positive real

Number for which D.E has non-zero solution.

4. The gummy substance present in raw silk fibre is

(A) Serine (B) Fibroin (C) Keratin (D) Sericin

Key: **(D)**

Sol: Sericin is a protein created by Bombyx Mori (silk worms) in the production of silk. Silk filament is held together by a gummy substance called silk sericin on silk gum.

5. The technique used for producing viscous rayon is

(A) Melt spinning (B) Wet spinning

(C) Dry spinning (D) Dry-jet wet spinning

Key: **(B)**

6. The yarn manufacturing technology that uses perforated drums for twisting is

(A) Ring spinning (B) Rotor spinning

(C) Friction spinning (D) Air-jet spinning

Key: **(C)**

Sol: Friction spinning on dref spinning is suitable for spinning coarse counts of yarns and consists of three distinct operations including feeding of fibres, fibre integration and twist insertion.

7. In roving frame, the distance between top and bottom aprons at the exit point is maintained by

(A) Spacer (B) Trumpet (C) Condenser (D) Pressure-bar

Key: **(A)**

8. Fabric structure related to weft knitting is

(A) Locknit (B) Reverse locknit (C) Double tricot (D) 1×1 Rib

Key: **(D)**

Sol: In the weft knitting process, when every wall alternates between plain and purl stitches on right and back sides, it is known as 1 *1 Rib.

9. The nonwoven technology which uses high-pressure water jets is

(A) Needle punching (B) Spunlacing

(C) Spunbonding (D) Melt blowing

Key: (B)

Sol: Spun lacing is a process of entangling a web of loose fibres on a porous belt to form a sheet structure by subjecting the fibres to multiple rows of fine high-pressure jets of water.

10. Cotton fibre length variation can be expressed by

(A) Uniformity index (B) Limit irregularity

(C) U% (D) Index of irregularity

Key: (A)

Sol: The variation in length for cotton fibres is generally expressed in terms of uniformity index.

$$U.R = \frac{50\% \text{ span length}}{2.5\% \text{ span length}}$$

11. A high value of drape coefficient indicates

(A) Limp fabric (B) Stiff fabric

(C) Compressible fabric (D) Smooth fabric

Key: (B)

Sol: Drape refers to the tendency how well a fabric can hang. Higher drops coefficient means lower drape value i.e., stiff fabric.

12. The process for removal of protruding fibres from fabric surface is

(A) Desizing (B) Scouring (C) Souring (D) Singeing

Key: (D)

Sol: Singing refers to burning-off for removal of protruding fibre from the surface of the fabric. It helps to produce an even surface.

13. Dimethylol dihydroxy ethylene urea (DMDHEU) is a

(A) Crease-resist agent (B) Flame retardant

(C) Softener (D) Soil repellent

Key: (A)

Sol: DMHEU is commonly used in durable-press finish as a wrinkle and crease-resisting.

14. Suppose $u(x,t)=\frac{1}{2}\left[g(x+ct)+g(x-ct)\right]$ is a solution of the following initial value problem of the wave equation.

$u_{tt}=9u_{xx}, u(x,0)=g(x), u_t(x,0)=0$

Then the value of c^2 is ______________.

Key: **(9)**

Sol: We know that $\frac{\partial^2 u}{\partial t^2}=c^2\frac{\partial^2 u}{\partial x^2}$ …(1)

is one-dimension wave equation

Comparing equation (1) with given wave equation

$u_{tt}=9u_{xx}\left(\text{i.e., }\frac{\partial^2 u}{\partial t^2}=9\frac{\partial^2 u}{\partial x^2}\right)$,

we get $c^2=9$

15. If the numerical solution of the initial value problem

$y'=\frac{t^2}{t+y^3}, y(0)=1$

is obtained by the Euler's method with step size of 0.2, then the value of y(0, 4), (rounded off to two decimal places), is __________.

Key: **(1.01)**

Sol: $f(t,y)=\frac{t^2}{t+y^3}, y(0)=1\Rightarrow y_0=1, t_0=0, h=0.2$ (h → step size)

By Euler's method,

$y_1=y_0+hf(t_0,y_0)$ ($y_1 = y(t_1) = y(0.2)$)

$=1+(0.2)f(0,1)$

$=1+(0.2)+\left(\frac{0}{0+1}\right)=1 \quad (\because t=t_0+h)$

$y_2=y_1+hf(t_1,y_1)$ ($y_2 = y(t_2) = y(0.4)$)

$=1+(0.2)f(0.2,1)=1+(0.2)\times\left(\frac{0.04}{0.2+1}\right)$

$=1+(0.2)\left(\frac{0.04}{1.2}\right)=1.0066\approx 1.01 \quad (\because t_2=t_1+h)$

16. Assuming the atomic mass of H = 1, C = 12, N = 14 and O = 16, the molecular mass of a repeat unit Nylon 6 fibre is ____________.

Key: **(113)**

Sol: Repeat unit of Nylon 6 fibre,

$NH-(CH_2)_5-CO$

Thus, Molecular mass $=14+1+(14\times5)+12+16$

$=15+70+12+16$

$=113$

17. A textile filament records at tensile stress of 0.3 GPa at a tensile strain of 0.04. Assuming Hookean behavior, the tensile modulus (GPa) of the filament, (rounded off to one decimal place), is __________.

Key: **(7.5)**

Sol: Tensile stress = 0.3 GPa

Tensile strain = 0.04

Thus, Tensile modulus $=\frac{\text{Tensile stress}}{\text{Tensile strain}}=\frac{0.3}{0.04}\text{GPa}=7.5\,\text{GPa}$

18. Number of fibres, each of 40 mm length and 0.16 tex fineness, in a tuft of 24 mg mass is _________.

Key: **(3750)**

Sol: Mass of tuft = 24 mg $=24\times10^{-3}\text{gm}$

Fibre fineness $=0.16\text{ tex}=\frac{0.6\text{gm}}{1000\text{ mtr}}$

Weight of 40mm length fibre $=\frac{0.16\text{gm}}{1000\text{mtr}}\times40\times10^{-3}\text{mtr}=0.16\times40\times10^{-6}\text{gm}$

Thus, Number of fibres $=\frac{24\times10^{-3}\text{gm}}{0.16\times40\times10^{-6}\text{gm}}=3750$

19. Twist (turns per inch) of a cotton yarn of 36 Ne count produced with a twist multiplier of $3.5\,\text{inch}^{-1}.\text{Ne}^{-0.5}$ is ____________.

Key: **(21)**

Sol: $TPI=TM\times\sqrt{Ne}$

$TPI=3.5\times\sqrt{36}$

$TPI=3.5\times6$

$TPI=21$

20. In winding, if traverse speed and package surface speed are the same, the angle of wind (in degree) is __________.

Key: **(45)**

Sol: In winding,

$$\tan\theta = \frac{V_d}{V_s}$$

$$\tan\theta = 1 \qquad [\text{If } V_d = V_s]$$

$$\boxed{\theta = 45°}$$

21. During air-jet weft insertion, if the diameter of the yarn increases by 20% then the percentage increase in drag force acting on the yarn would be __________.

Key: **(20)**

Sol: In air-jet weft insertion

Drag force $\propto$ diameter

So, % increase in drag force $= \frac{20x}{x} = 20\%$

22. If the ratio of the linear densities (denier) of two circular fibers is 3, the corresponding ratio of their diameters, (rounded off to two decimal places), is ________

Key: **(1.73)**

Sol: Since, Denier $\propto (\text{diameter})^2$

So, $\frac{\text{Dia}_1}{\text{Dia}_2} = \sqrt{\frac{\text{Denier}_1}{\text{Denier}_2}}$

$$\frac{\text{Dia}_1}{\text{Dia}_2} = \sqrt{\frac{3}{1}} = 1.732 \sim \boxed{1.73}$$

23. If the sample size (n) is 25 and the standard deviation (σ) of population is 2, then the standard error (SE) of sample mean, (rounded off to one decimal place), is ____________.

Key: **(0.4)**

Sol: Standard error $= \frac{\text{standard deviation}(\sigma)}{\sqrt{\text{sample size}(n)}} = \frac{2}{\sqrt{25}} = \frac{2}{5} = 0.4$

24. The wet expression for padding mangle is set at 80%. If the add-on of a flame retardant chemical on the fabric is 2% then the concentrating (g/L) of the chemical in the pad bath is ___________.

Key: (25)

Sol: Let weight of fabric = 100 kg

Add-on = 2% of 100 = 2 kg $\approx$ 200 gm

Wet expression = 80% = 80 lit

Thus, concentration of the pad bath $= \dfrac{2000\,\text{gm}}{80\,\text{lit}} = \boxed{25\,\text{gm/lit}}$

25. Assuming Beer-Lambert law is applicable for dilute solutions, if the molar concentration of dye in the solution is doubled then the percentage increase in absorbance would be _____________.

Key: (100)

Sol: Assuming Beer-Lambert law,

Molar concentration $\propto$ absorbance

Thus, % increase in absorbance $= \dfrac{\text{change in molar concentration}}{\text{original concentration}} \times 100$

$$= \frac{2x - x}{x} \times 100$$

$$= 100\%$$

26. The value of a, for which the following system of equations

$2x + y + 3z = a,\ x + y = 2,\ y + z = 2$

is consistent, is

(A) 6 (B) 4 (C) 3 (D) 2

Key: (A)

Sol: n = 3 unknowns, 3 non-homogeneous equation AX = B

$$C = [A/B] = \left[\begin{array}{ccc|c} 2 & 1 & 3 & a \\ 1 & 0 & 1 & 2 \\ 0 & 1 & 1 & 2 \end{array}\right]$$

$$2R_2 \sim R_1 \sim \left[\begin{array}{ccc|c} 2 & 1 & 3 & a \\ 0 & -1 & -1 & 4-a \\ 0 & 1 & 1 & 2 \end{array}\right]$$

$$R_3 + R_2 \sim \left[\begin{array}{ccc|c} 2 & 1 & 3 & a \\ 0 & -1 & -1 & 4-a \\ 0 & 0 & 0 & 6-a \end{array}\right]$$ is Row Echelons form

For consistent equations we have

$\text{rank}(A) = \text{rank}(C)$

since $\text{rank}(A) = 2$

$\therefore \text{rank}(C) = 2$ i.e., two non – zero rows only

27. If the function f(x, y) is defined by

$$f(x, y) = x^3 - \frac{3}{2}x^2y^2 + y^3, \ xy \in \mathbb{R},$$

Then,

(A) Neither (0, 0) nor (1, 1) is a critical point

(B) (0, 0) is a critical point but (1, 1) is NOT a critical point

(C) (0, 0) is NOT a critical point but (1, 1) is a critical point

(D) (0, 0) and (1, 1) are both critical points

Key: (D)

Sol: $\frac{\partial f}{\partial x}(= p) = 3x^2 - 3xy^2$

$\frac{\partial f}{\partial y}(= q) = -3x^2y + 3y^2$

$p = 0$ gives $x(x - y^2) = 0 \Rightarrow x = 0$

$x = y^2 \quad \ldots(1)$

$q = 0$ gives $y(y - x^2) = 0 \Rightarrow y = 0;$

$y = x^2 \quad \ldots(2)$

Solving (1) and (2), we get (1, 1)

$\therefore$ (0, 0) and (1, 1) are both critical points (stationary points)

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

Assertion: Draw texturing of isotactic polypropylene (POY) at a relatively high speed is possible despite high crystallinity of the feeder yarn.

Reason: Isostatic polypropylene (POY) has majorly smectic mesomorphic phase.

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

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

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

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

Key: (A)

29. Group I gives a list of fibres and Group II contains their applications. Match the fibre with its application.

Group-I	Group-I
(P) Polypropylene	**1.** Mountaineering rope
(Q) Kevlar	**2.** Firefighter's suit
(R) Nylon 6,6	**3.** Bulletproof jacket
(S) Nomex	**4.** Geotextiles

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

Key: **(B)**

Sol: Kevlar is an aramid fibre and is extremely strong and lightweight used in aerospace engineering, body armor, bullet proof vests etc.

Nomex is used in electrical laminates such as circuit boards as well as fire proof structures.

30. Techniques used for determination of orientation in fibres from amongst the followings are

(P) Birefringence measurement
(Q) Scanning electron microscopy
(R) X-ray diffraction
(S) Differential scanning calorimetry

(A) P and Q (B) P and R (C) Q and R (D) Q and S

Key: **(B)**

Sol: Birefringence and x-ray diffraction are used far the measurement of fibre orientation.

Scanning electron microscopy (SEM) is used for determination of surface morphology.

DSC is used for the determination of heat capacity of a polymer, and thermal transitions of polymer including glass transition temperature and melting point.

31. In a modern high performance blowroom line, the correct sequence of machines is

(A) Automatic bale opener $\rightarrow$ Blender $\rightarrow$ Coarse cleaner $\rightarrow$ Fine cleaner
(B) Automatic bale opener $\rightarrow$ Blender $\rightarrow$ Fine cleaner $\rightarrow$ Coarse cleaner
(C) Automatic bale opener $\rightarrow$ Coarse cleaner $\rightarrow$ Fine cleaner $\rightarrow$ Blender
(D) Automatic bale opener $\rightarrow$ Coarse cleaner $\rightarrow$ Blender $\rightarrow$ Fine cleaner

Key: **(D)**

Sol: In high performance modern below-room line, the process efficiency, and flexibility is very high compared to the conventional blow-room line. It consists of coarse cleaner followed by blending and then fire cleaning is done.

32. As compared to cylinder, doffer has

(A) Lower rotational speed and lower wire point density

(B) Lower rotational speed and higher wire point density

(C) Higher rotational speed and lower wire point density

(D) Higher rotational speed and higher wire point density

Key: **(A)**

Sol: Rotational speed sequence: Cylinder > licker in > Doffer

33. Assuming no fibre loss in draw frame, if draft is equal to doubling then the delivered sliver, as compared to fed silver, will exhibit

(A) Decreased mass variation and higher linear density

(B) Increased mass variation and lower linear density

(C) Improved fibre orientation without change in linear density

(D) Poor fibre orientation without change in linear density

Key: **(C)**

Sol: Since, draft = doubling

No change in linear density will take place. Also drafting operation improves the orientation of the fibre.

34. Group I gives a list of loom motions and Group II contains loom systems. Match the motion from Group I with the corresponding system from Group II

Group-I	Group-I
(P) Shedding	**1.** Matched cam
(Q) Picking	**2.** Seven wheel
(R) Beat-up	**3.** Rapier
(S) Take-up	**4.** Jacquard

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

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

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

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

Key: **(C)**

35. Group I gives a list of terms to woven fabrics and Group II contains equivalent terms related to knitted fabrics. Match the term from Group I with the equivalent term from Group II.

Group-I	Group-I
(P) Cover	**1.** Interlock
(Q) Double-cloth	**2.** Wales
(R) Warp	**3.** Tightness
(S) Weft	**4.** Courses

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

Key: **(B)**

Sol: In knitting, a wale is a column of loops running length wise corresponding to the warp of woven fabric; a course is a cross wise row of loops corresponding to wefts.

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

Assertion: In shuttle loom, late shedding is preferred for filament weaving.

Reason: In late shedding, the timing of shed dwell matches with the timing of shuttle travel through the shed, and therefore, it minimizes the rubbing of warp yarns.

(A) Both [a] and [r] are true and [r] is the correct reason for [a]
(B) Both [a] and [r] are true but [r] is not the correct reason for [a]
(C) Both [a] and [r] are false
(D) [a] is true but [r] is false

Key: **(A)**

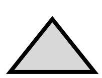
37. The typical shapes of comb sorter diagram and fibrogram of polyester fibres of equal cut length will be

(A) Triangular and rectangular respectively
(B) Rectangular and triangular respectively
(C) Rectangular and S-shaped respectively
(D) S-shaped and triangular respectively

Key: **(B)**

Sol: For polyester fibres of equal cut length.

Comb sorter →  (rectangular)

Fibrogram →  (triangular)

38. In Classimat system, the yarn fault H2, as compared to yarn fault C3, is

(A) Thicker and longer
(B) Thicker and shorter
(C) Thinner and longer
(D) Thinner and shorter

Key: (C)

Sol: Classimat faults:

$A4, B4, A3, B3, C3 \rightarrow$ Thicker

$A2, B2, M2 \rightarrow$ Thinner

So, H2 is thinner and longer as compared to C3.

Length class (H) $\rightarrow$8-32cm (long thin fault)

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

Assertion: Application of an optical brightening agent makes the white fabrics appear brighter.

Reason: Optical brightening agents absorb energy in the visible region and radiate back in the UV region.

(A) Both [a] and [r] are true and [r] is the correct reason for [a]
(B) Both [a] and [r] are true but [r] is not the correct reason for [a]
(C) Both [a] and [r] are false
(D) [a] is true but [r] is false

Key: (D)

Sol: OBA absorbs the energy in UV region and radiate back in the visible region is OBA's makes the fabric much brighter due to its emission in visible region. So, the assertion is true and the given reason is false.

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

Assertion: Nylon is dyed with acid dyes in the acidic medium.

Reason: Nylon assumes positive charge in the acidic medium and thus, attracts the negatively charged acid dye molecules.

(A) Both [a] and [r] are true and [r] is the correct reason for [a]
(B) Both [a] and [r] are true but [r] is not the correct reason for [a]
(C) Both [a] and [r] are false
(D) [a] is true but [r] is false

Key: (A)

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

Assertion: Discharge printing of dyed polyester fabric is not possible.

Reason: The discharging agents damage the polyester fibres significantly.

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

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

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

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

Key: (C)

Sol: Polyester fabric is dyed with dischargeable disperse dye and then printed with paste containing reducing agent for white discharge.

42. If 3 and 6 are eigen values of the matrix

$$\begin{pmatrix} 5 & 2 & 0 \\ 2 & \mu & 0 \\ -3 & 4 & 6 \end{pmatrix}$$

Then the value of μ is __________.

Key: (5)

Sol: Since 3 and 6 are eigen values of given 3 × 3 matrix, Let λ be the third eigen value then

$$\underbrace{3+6+\lambda}_{\text{Sum of eigen values}} = \underbrace{5+\mu+6}_{\text{trace of matrix}}$$

$\Rightarrow \lambda - \mu = 2 \ldots (1)$

Product of eigen values = determinant of matrix

$\Rightarrow 3\times 6\times \lambda = 6\times(5\mu-4)$

$\Rightarrow 3\times(\mu+2) = 5\mu-4 \quad (\text{Using } (1))$

$\Rightarrow 2\mu = 10 \Rightarrow \mu = 5$

43. If y(x) is a solution of

$x^2y'' - 4xy' + 6y = 0,\ y(-1) = 1,\ y'(-1) = 0$

Then the value of y(2) is __________.

Key: **(28)**

Sol: $x^2\dfrac{d^2y}{dx^2} - 4x\dfrac{dy}{dx} + 6y = 0$ …(1) is Cauchy Euler equation

$\Rightarrow \theta(\theta-1)y - 4\theta y + 6y = 0,$ Where $\theta = \dfrac{d}{dz}, z = \ell nx \Rightarrow e^z$

$\Rightarrow (\theta^2 - 5\theta + 6)y = 0$ …(2) is linear D.E

A.E is $m^2 - 5m + 6 = 0$

$\Rightarrow (m-2) - (m-3) = 0$

$\Rightarrow m = 2,3$ (two distinct real roots)

$\therefore$ General solution is y = C.F

$\Rightarrow y = c_1e^{2z} + c_2e^{3z} \Rightarrow y = c_1x^2 + c_2x^3$ …(1)

$\Rightarrow y' = 2c_1x + 3c_2x^2$ …(2)

Using $y(-1) = 1$ and $y'(-1) = 0$ i.e., $y = 1, x = -1$ and

$y' = 0, x = -1,$ (1) and (2) gives $1 = c_1 - c_2 - (3)$ and $0 = -2c_1 + 3c_2$

Solving, we get $c_1 = 3, c_2 = 2$ $\therefore y = 3x^2 + 2x^3$

$\therefore$ at x = 2 $\Rightarrow y^2 = 12 + 16 = 28$

44. In melt spinning, the mass throughput rate of polymer is 210 g/min, the winding speed is 3000 m/min, and the linear density of the yarn produced is 200 denier. The effective draw ratio, (rounded off to two decimal places), is ___________.

Key: **(3.15)**

Sol: Linear density of the polymer $= \dfrac{210\ \text{gm/min}}{3000\ \text{mtr/min}} = \dfrac{210\ \text{gm}}{3000\ \text{mtr}} = 70\ \text{tex}$

Linear density of the yarn = 200 denier $= \dfrac{200\ \text{gm}}{9000\ \text{mtr}} = \dfrac{200}{9}\ \text{tex}$

Thus, draw ratio $= \dfrac{70\ \text{tex}}{\frac{200}{9}\ \text{tex}} = \dfrac{70 \times 9}{200} = 3.15$

45. The molecular weight (M) of a polymer is determine from Mark-Houwink Equation by using coefficient $K = 11.5 \times 10^{-3}\, m\ell/g$ and exponent a = 0.73. If the measured intrinsic viscosity $[\eta]$ of the solution is $6.0 \times 10^{2}\ m\ell/g$ then the value of $M \times 10^{-6}$, (rounded off to two decimal places), is _________.

Key: (2.87)

Sol: Using Mark-Houwink's equation

$$[\eta] = kM^{a}$$

$$6 \times 10^{2}\ m\ell/gm = 11.5 \times 10^{-3}\ m\ell/gm \times M^{0.73}$$

$$\frac{6 \times 10^{5}}{11.5} = M^{0.73}$$

Taking $\log_e$ both sides, we get

$$\ell n\left(\frac{6 \times 10^{5}}{11.5}\right) = 0.73\ \ell n\ M$$

$$10.86 = 0.73\ \ell n\ M$$

$$\ell nM = 14.87$$

$$M = e^{14.87}$$

$$M = 2.87 \times 10^{6}$$

So, value of $M \times 10^{-6} = \boxed{2.87}$

46. A roving of 2 Ne count is fed to a ring frame set with a mechanical draft of 30. If the length of the drafted strand delivered from the nip of the front rollers is reduce by 3% due to twist the count (Ne) of the yarn, (rounded off to one decimal place), is ___________

Key: (58.2)

Sol: $$\text{Draft} = \frac{\text{Delivery count}}{\text{Feed count}}$$

$$\text{Delivery count} = 30 \times 2 = 60^{s}\ \text{Ne}$$

$$\text{Reduction in length due to twist } = 3\% = \frac{3}{100} \times 60 = 1.8$$

So, the count (Ne) of the yarn = 60 – 1.8 = 58.2

47. In a 3 over 3 drafting arrangements, the diameter of all bottom rollers is 28 mm. The back zone draft is 1.3 and the front zone draft is 6. If the back bottom roller is eccentric, then the wavelength (mm) of the front zone draft is 6. If the back bottom roller is eccentric then the wavelength (mm) of the resulting fault in the drawn sliver, (rounded off to two decimal places), is ____________.

Key: **(686)**

Sol: For 3 over 3 drafting arrangement,

Diameter of bottom roller = 28mm

Back draft = 1.3

Front draft = 6

Total draft = 6 × 1.3 [Back draft × Front draft] = 7.8

Wavelength (mm) of resulting fault in down silver $= \pi D \times 6 \times 1.3 = \pi \times 28 \times 6 \times 1.3 = 685.77$

48. For a given woven fabric, fractional cover is 0.5 for both warp and weft. The fractional cover of the fabric, (rounded off to two decimal places), is __________.

Key: **(0.75)**

Sol: Given, $C_1 = 0.5$

$C_2 = 0.5$

So, Fractional cover $(C) = C_1 + C_2 - C_1C_2$

$= 0.5 + 0.5 - 0.5 \times 0.5$

$= 1 - 0.25$

$= 0.75$

49. For a shuttle loom, producing plain woven fabric, if each of the dwell periods of the shedding cam corresponds to one-third of crank shaft rotation, the sum of the two dwell periods of the cam (in degree) is _________.

Key: **(120)**

Sol: For shuttle loom

Sum of two dwell period of cam $= \frac{0 + 360°}{3} = 120°$

50. If the moisture regain (%) and moisture content (%) of a fibre are the same then the value of moisture regain (%) is ____________.

Key: **(0)**

Sol: Since, $M.C = \frac{MR}{1 + \frac{MR\%}{100}}$

For, $M.R\% = M.C\%\,(\text{given})$

The above condition can be satisfied at

$MR\% = 0.$ In all other cases,

$MR\% > MC\%$

$$\text{Moisture region } = \frac{\text{Weight of water}}{\text{Oven dry weight of material}}$$

$$\text{Moisture content } = \frac{\text{Weight of water}}{\text{Total weight of the material}}$$

51. Mass of 120 yards of cotton yarn is 3g. The count (Ne) of yarn, (rounded off to one decimal place), is ________.

Key: (21.6)

Sol: Since, 1 yard = 0.9144 mtr

120 yards = 120 × 0.9144 mtr = 109.72 mtr

$$\text{So, gm/mtr of cotton yarn } = \frac{3}{109.72} = 0.0273$$

$$\text{Thus, Count (Ne) of the yarn } = \frac{0.5905}{(\text{gm/mtr})} = \frac{0.5905}{0.0273} = \boxed{21.6}$$

52. A woven fabric with area density of 300 g/m^2 tested by strip tensile test method, keeping the specimen width as 5 cm and gauge length as 25 cm. If the breaking load is 900N, the tenacity (cN/tex) of the fabric is ___________.

Key: (6)

Sol: Specimen width = 5cm

Areal density = 300 gm/mtr^2

$$\text{Tex} = 300\,\text{gm/mtr}^2 \times \frac{5}{100}\,\text{mtr} = \frac{15\text{ gm}}{1000\text{ mtr}} \times 1000 = 15000\text{ tex}$$

$$\text{Breaking load } = 900\text{ N} = 900 \times 100\text{ cN}$$

$$\text{Thus, Tenacity}\left(\frac{\text{cN}}{\text{tex}}\right) = \frac{900 \times 100\text{cN}}{15000\text{ tx}} = 6$$

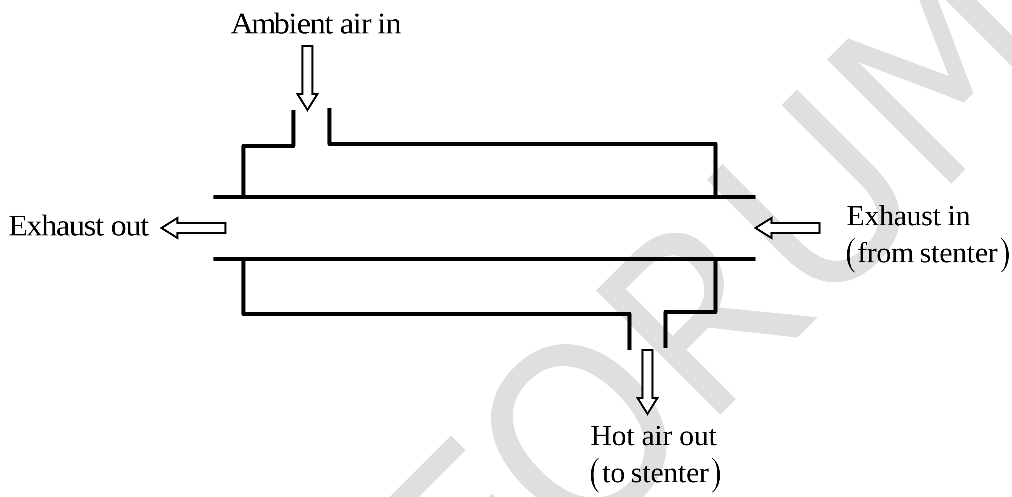
53. A 50 tex yarn with mass CV of 12.5% is produced from staple polyester fibres each of 4.5 denier fineness. The index of irregularity of the yarn, (rounded off to two decimal places), is ________.

Key: (1.25)

Sol: Mass CV% $= \frac{\text{yarn tex}}{\text{fibre tex}} = \frac{50\text{tex}}{\frac{4.5}{9}\text{tex}} = \frac{50\times9\times10}{45} = 100$

So, Index of irregularity for polyester yarn $= \frac{CV^{\%}_{mass}}{\sqrt{N}} = \frac{12.5\%}{\sqrt{100}} = 1.25\%$

54. A counter flow heat exchanger is attached to a stenter for waste heat recovery.



Heat Exchanger

Consider the following data:

Ambient temperature: 30°C

Temperature of exhaust from stenter: 150°C

Temperature of exhaust at exit of heat exchanger: 100°C

Specific heat of exhaust: 0.42 $\text{kcal. deg}^{-1}.\text{kg}^{-1}$

Specific heat of air: 0.24 $\text{kcal.deg}^{-1}.\text{kg}^{-1}$

At steady state, if the mass flow rates of the exhaust gas the incoming air are the same, assuming heat loss as zero, the temperature (°C) of the air at the exit of the heat exchanger (towards the stenter), (rounded off to one decimal place), is _________.

Key: **(117.5)**

Sol: Using mixing rule for a counter flow heat exchanger,

$m_1c_1(v_1 - v_m) = m_2c_2(v_m - v_1)$

Where, $m_1, m_2 \rightarrow$ mass of substance 1, 2

$C_1, C_2 \rightarrow$ Specific heat capacity of substance 1, 2

$v_1, v_2 \rightarrow$ temperature of substance 1, 2

$v_m \rightarrow$ temperature of the mixture in °C.

At steady state, $m_1 = m_2 = m$

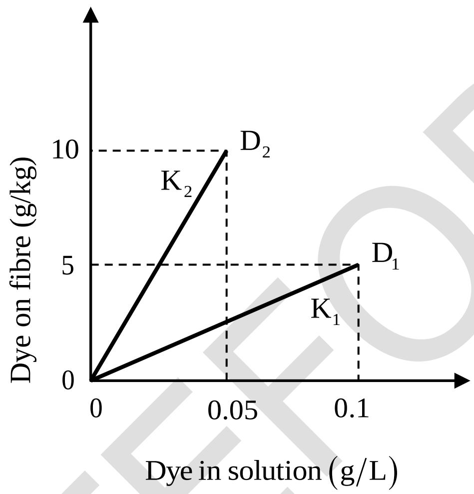
Since, Heat loss = 0

Then $m \times 0.24 \times (t - 30) = m \times 0.24 \times (150 - 100)$

$\Rightarrow 0.24(t - 30) = 0.42 \times 50 \Rightarrow t - 30 = 87.5$

$\Rightarrow \boxed{t = 117.5°}$ (Temperature of air at the exit of heat exchanger)

55. Consider the following isotherms at equilibrium for two disperse dyes D_1 and D_2 dyed on polyester. If the partition coefficient of these are K_1 and K_2, respectively, the value of $\frac{K_2}{K_1}$ is ___________.



Key: **(4)**

Sol: For disperse dye D_1,

Partition coefficient $(k_1) = \frac{5(D_f)}{0.1(D_s)} = 50$

For disperse dye D_2

Partition coefficient $k_2 = \frac{D_f}{D_s} = \frac{10}{0.05}$

$k_2 = \frac{10 \times 100}{5}$

$k_2 = 200$

So, $\frac{k_2}{k_1} = \frac{200}{50} = 4$