**1** If $A = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ and B be a $3 \times 3$ matrix whose entries are {1,2,3,4,5}, then the number of possible matrices B such that AB = BA are :

(1) 240 (2) 320 (3) 120 (4) 100

**Ans.** **(3)**

**Sol.** $A = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

Let $B = \begin{bmatrix} a & b & c \\ p & q & r \\ x & y & z \end{bmatrix}$

Now AB = BA

$$\Rightarrow \begin{bmatrix} p & q & r \\ a & b & c \\ x & y & z \end{bmatrix} = \begin{bmatrix} b & a & c \\ q & p & r \\ y & x & z \end{bmatrix}$$

$\Rightarrow p = b$ , $a = q$, $r = c$, $x = y$, & $z = z$

Hence number of such matrices are 5! = 120

**2** The number of all possible numbers less than 10000 that can be formed using the digits 0, 2, 4, 6, 8 (without repetition) are :

**Ans.** **165**

**Sol.** 1 digit numbers = 5

2 digit numbers = $\underline{4}.\ \underline{4}$ = 16

3 digit numbers = $\underline{4}.\ \underline{4}\ \underline{3}$ = 48

4 digit numbers = $\underline{4}.\ \underline{4}\ \underline{3}\ \underline{2}$ = 96

Total = 5 + 16 + 48 + 96 =165

**3** If a circle $36x^2 + 36y^2 - 108x + 120y + c = 0$ neither touches nor cuts the co-ordinate axis and point of intersection of lines $x - 2y = 4$ and $2x - y = 5$ also lies inside the circle, then the value of c lies in :

3 digit numbers = $\underline{4}.\underline{4}\,\underline{3} = 48$

4 digit numbers = $\underline{4}.\underline{4}\,\underline{3}\,\underline{2} = 96$

Total = 5 + 16 + 48 + 96 =165

**3** If a circle $36x^2 + 36y^2 - 108x + 120y + c = 0$ neither touches nor cuts the co-ordinate axis and point of intersection of lines $x - 2y = 4$ and $2x - y = 5$ also lies inside the circle, then the value of c lies in :

(1) $81 < c < 156$ (2) $100 < c < 156$ (3) $81 < c < 150$ (4) $100 < c < 150$

**Ans.** **(2)**

**Sol.** Intersection point of $2x - y = 5$ and $x - 2y = 4$ is $(2, -1)$

So, $(2, -1)$ lies indie the circle $\Rightarrow S_1 < 0$

$36(2)^2 + 36(-1)^2 - 108(2) + 120(-1) + c < 0$

$c < 156$ ........(i)

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**Reg. Office & Corp. Office :** CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005

**Ph. No.:** +91-744-2777777, 2777700 | **FAX No. :** +91-022-39167222

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$\because$ circle $36x^2 + 36y^2 - 108x + 120y + c = 0$ neither touches nor cuts the co-ordinate axis so

$$g^2 - c < 0 \Rightarrow \left(\frac{-3}{2}\right)^2 - \frac{c}{36} < 0 \Rightarrow c > 81 \text{..........(ii)}$$

$$\text{and } f^2 - c < 0 \Rightarrow \left(\frac{5}{3}\right)^2 - \frac{c}{36} < 0 \Rightarrow c > 100 \text{ ....(iii)}$$

**4.** If line $2x + y = k$, $(k < 0)$ is a tangent to both the curves $x^2 - y^2 = 3$ and $y^2 = \alpha x$, then the value of $\alpha$ is

**Ans.** **24.00**

**Sol.** Given slope of line (m) = – 2

slope form of tangent to the curve $x^2 - y^2 = 3$ is $y = mx \pm \sqrt{a^2m^2 - b^2}$

$\Rightarrow y = -2x \pm 3$

On comparing, with the equation $2x + y = k$, $(k < 0) \Rightarrow k = -3$

Now, slope form of tangent to the parabola $y^2 = \alpha x$ is $y = mx + \dfrac{\alpha}{4m}$

But m = – 2 so

$$y = -2x + \frac{\alpha}{4(-2)} \Rightarrow -3 = \frac{\alpha}{4 \times (-2)}$$

$\alpha = 24$

**5.** The number of all possible values of $n \in \{1,2,3,\_\_\_\_ 100\}$ which satisfy the condition $11^n > 10^n + 9^n$ is:

**Ans.** (96)

**Sol.** Let $11^n > 10^n + 9^n$ $\qquad n \in \{1,2,3,\_\_\_\_ 100\}$

$\Rightarrow 11^n - 9^n > 10^n$

$\Rightarrow (10+1)^n - (10-1)^n > 10^n$

$\Rightarrow 2\,[{}^nC_1 10^{n-1} + {}^nC_3 10^{n-3} + {}^nC_5 10^{n-5} + \ldots\ldots] > 10^n$

$\Rightarrow \frac{1}{5}[{}^nC_1 10^n + {}^nC_3 10^{n-2} + {}^nC_5 10^{n-4} + \ldots\ldots] > 10^n$

$\Rightarrow \frac{1}{5}[{}^nC_1 + {}^nC_3 10^{-2} + {}^nC_5 10^{-4} + \ldots\ldots] > 1$

Clearly the above inequality is true for $n \geq 5$

For n = 4 we have $\frac{1}{5}\left[4 + \frac{4}{10^2}\right] = \frac{4}{5}\left(\frac{101}{100}\right) < 1$, Rejected

Hence, number of such $n \in \{1,2,3, \_\_\_\_ 100\}$ is equal to 96

**6.** If an AP, $S_{10} = 530$ & $S_5 = 140$ (where $S_n$ denotes the sum of first n terms of an AP), then the value of $S_{20} - S_6$ is

(1) 1562 (2) 1862 (3) 1762 (4) 1662

**Ans.** (2)

**Sol.** $S_{10} = 530$

$\frac{10}{2}[2a + 9d] = 530$

$2a + 9d = 106$ … (1)

$S_5 = 140$

$\frac{5}{2}[2a + 4d] = 140$

$2a + 4d = 56$ … (2)

$5d = 50$

$d = 10$

$a = 8$

Now,

$S_{20} - S_6 =$

$10[2a + 19d] - 3[2a + 5d]$

$14a + 175d$

$14 \times 8 + (175)10 = 1862$

**7.** The value of r for which the term independent of x in the expansion of $\left(2x^r + \frac{1}{x^2}\right)^{10}$ is 180 is:

(1) 7 (2) 8 (3) 9 (4) 10

**Ans.** (2)

**Sol.** $T_{k+1} = {}^{10}C_k\,(2x^r)^{10-k}\,(x)^{-2k} \Rightarrow {}^{10}C_k\,2^{(10-k)}.\,x^{10r-rk-2k}$

Now, $10r - rk - 2k = 0 \Rightarrow r = \frac{2k}{10-k}$

And ${}^{10}C_k\,(2)^{10-k} = 180 \Rightarrow k = 8$

$2 \times 8$

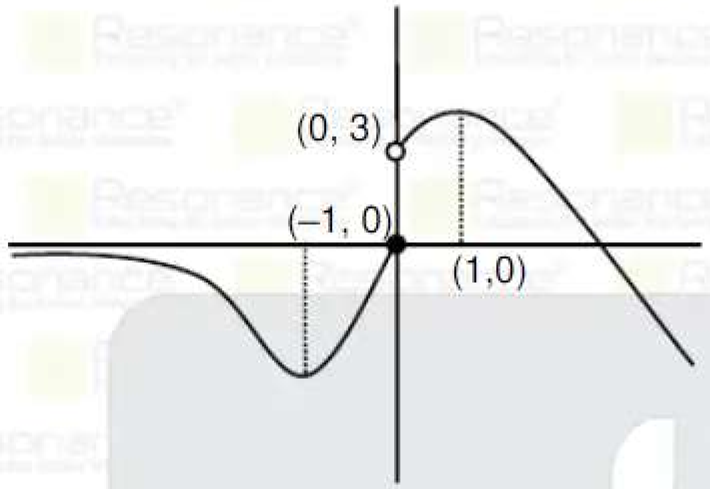
(1) $\left(-1,\frac{3}{2}\right)$ (2) (0, 1) (3) $\left(\frac{-3}{2},1\right)$ (4) $\left(\frac{1}{2},2\right)$

**Ans.** (B)





**Sol.** $f'(x)=\begin{cases}-4x^2+4x & , x>0\\ 3(x.e^x+e^x) & , x\le 0\end{cases}$




**9.** If $z^2+3\bar{z}=0$ has n solutions, then the value of $\sum_{k=0}^{\infty}\frac{1}{n^k}$ is :

**9.** If $z^2 + 3\bar{z} = 0$ has n solutions, then the value of $\sum_{k=0} \frac{1}{n^k}$ is :

(1) $\frac{3}{4}$ (2) $\frac{4}{3}$ (3) $\frac{5}{5}$ (4) $\frac{1}{2}$

**Ans.** (2)

**Sol.** Let z = x + iy

$(x + iy)^2 + 3(x - iy) = 0$

$x^2 - y^2 + 2ixy + 3x - 3iy = 0$

$x^2 - y^2 + 3x = 0$ & $2xy - 3y = 0$

**Case-1:** y = 0

$x^2 - y^2 + 3x = 0$

$\Rightarrow x = 0$ or $x = -3$

Solutions are z=0 and z=–3

**Case-2:** $x = \frac{3}{2}$

$x^2 - y^2 + 3x = 0$

$\Rightarrow y = \frac{3\sqrt{3}}{2}$ or $y = \frac{-3\sqrt{3}}{2}$

Solutions are $z = \frac{3}{2} + i\frac{3\sqrt{3}}{2}$ and $z = \frac{3}{2} - i\frac{3\sqrt{3}}{2}$

Total number of solutions = n = 4

So $\sum_{k=0}^{\infty} \frac{1}{4^k} = \frac{1}{1-\frac{1}{4}} = \frac{4}{3}$ Ans.

**10** The number of solutions of the equation $\sin^7 x + \cos^7 x = 1$ in the interval $[0, 4\pi]$ is :

(1) 7 (2) 9 (3) 14 (4) 5

**Ans.** (4)

**Sol.** $\sin^2 x + \cos^2 x = 1$, $\sin^2 x \le 1$ and $\cos^2 x \le 1$

$\sin^7 x \le \sin^2 x$

$\cos^7 x \le \cos^2 x$

so, $\sin^7 x + \cos^7 x \le 1$

$\sin^7 x + \cos^7 x = 1$ when $\sin^7 x = \sin^2 x$ & $\cos^7 x = \cos^2 x$

**Case-1 :** $\sin x = 0, \cos x = 1 \Rightarrow x = 0, 2\pi, 4\pi$

**Case-2 :** $\sin x = 1, \cos x = 0 \Rightarrow x = \frac{\pi}{2}, \frac{5\pi}{2}$

Total number of solutions = 5

**11.** The sum of all natural numbers belonging to the set {1, 2, 3 ……. 100}, whose HCF with 2304 is 1, is

(1) 2449 (2) 1633 (3) 1449 (4) 2633

**Ans.** (2)

**Sol.** $2304 = 2^8 \cdot 3^2$

Hence n can not be multiple of 2 or 3

Then sum is

$\Rightarrow n(1) - (n(2) + n(3) - n(6))$

(where n(a) means the sum of all numbers belonging to the set {1, 2, 3 …..100},which are divisible by a)

$$\Rightarrow \frac{100\times101}{2} - \frac{2\times50\times51}{2} - 3\times\frac{33\times34}{2} + 6\times\frac{17\times16}{2}$$

$\Rightarrow 5050 - 2550 - 1683 + 816$

$\Rightarrow 1633$

**12.** If f(x) is a continuous function defined as $f(x) = \begin{cases} \frac{x^3}{(1-\cos 2x)^2}\ln\left(\frac{1+\alpha x e^x}{(1+xe^x)^2}\right) & ; x < 0 \\ \alpha & ; x \ge 0 \end{cases}$ ,then the value

**12.** If f(x) is a continuous function defined as $f(x) = \begin{cases} (1-\cos 2x)^2 \quad (1+xe^x)^2 & ; x<0 \\ \alpha & ; x \ge 0 \end{cases}$ ,then the value of $\alpha$ is

(1) $\frac{-2}{3}$ (2) $\frac{2}{3}$ (3) $\frac{1}{3}$ (4) $\frac{-1}{3}$

**Ans.** (1)

**Sol.** $= \lim_{x \to 0^-} \frac{x^3}{(1-\cos 2x)^2} \ln\left(\frac{1+\alpha x e^x}{(1+xe^x)^2}\right)$





$= \lim_{x \to 0^-} \frac{x^3 \times x}{4\sin^4 x} \frac{\ln(1+\alpha x e^x) - 2\ln(1+xe^x)}{x}$

$= \lim_{x \to 0^-} \frac{1}{4} \frac{\ln(1+\alpha x e^x) - 2\ln(1+xe^x)}{x}$

$= \lim_{x \to 0^-} \frac{1}{4} \left\{ \frac{\ell n(1+\alpha x e^x)\alpha e^x}{\alpha e^x} - \frac{2\ell n(1+xe^x)}{\alpha e^x} e^x \right\}$

$= \lim_{x \to 0^-} \frac{1}{4} \{\alpha e^x - 2e^x\}$

$\frac{\alpha-2}{4}=\alpha \Rightarrow \alpha=\frac{-2}{3}$

**13** If the domain of $f(x)=\frac{\cos^{-1}\sqrt{x^2-x+1}}{\sqrt{\sin^{-1}\left(\frac{2x-1}{2}\right)}}$ is $(\alpha+\beta]$, then the value of $\alpha+\beta$ is :

(1) $\frac{1}{2}$ (2) $\frac{3}{2}$ (3) 1 (4) 2

**Ans.** (2)

**Sol.** $0 \le x^2-x+1 \le 1$ and $0 < \frac{2x-1}{2} \le 1$

$\Rightarrow$ $x(x-1) \le 0$ & $1 < 2x \le 3$

$\Rightarrow$ $x \in [0,1] \cap x \in \left(\frac{1}{2},\frac{3}{2}\right]$

$\Rightarrow$ $x \in \left(\frac{1}{2},1\right]$

Hence $\alpha+\beta=\frac{1}{2}+1=\frac{3}{2}$

**14.** Let $E_1$ and $E_2$ be two Ellipses with same eccentricity. Where $E_1=\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$, $(a > b)$ and $E_2$ is such that it passes through the end points of major axis of $E_1$ also end points of minor axis of $E_1$ are foci of $E_2$. Find the eccentricity of $E_1$

(1) $\sqrt{\frac{\sqrt{5}-3}{2}}$ (2) $\sqrt{\frac{\sqrt{5}+3}{2}}$ (3) $\frac{\sqrt{5}+1}{2}$ (4) $\frac{\sqrt{5}-1}{2}$

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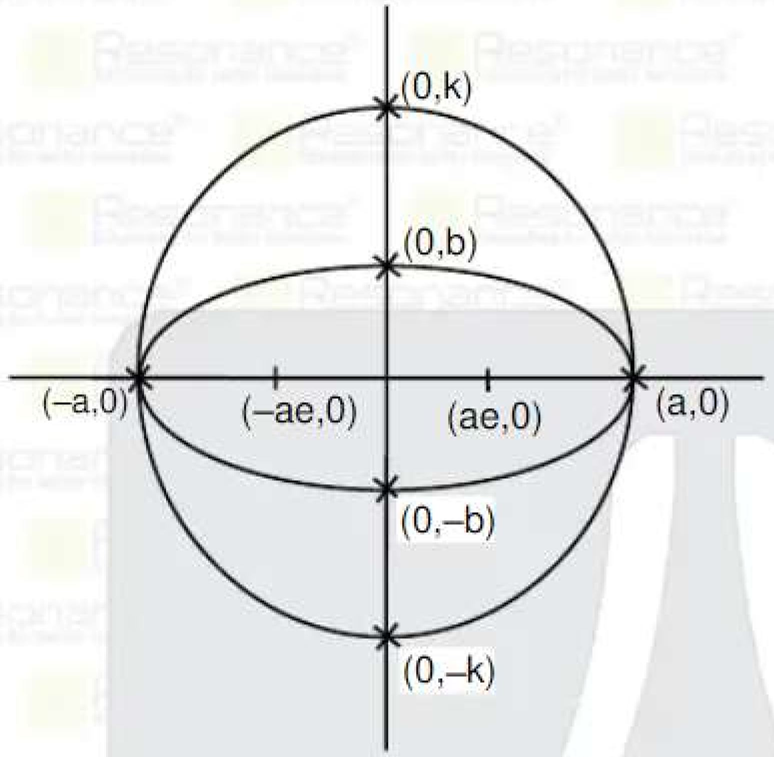
**Ans.** (4)

**Sol.**




Eccentricity of $E_1$ is e $\Rightarrow e^2 = 1 - \frac{b^2}{a^2}$

Eccentricity of $E_2$ is e $\Rightarrow e^2 = 1 - \frac{a^2}{k^2}$

So, $e^2 = 1 - \frac{b^2}{a^2} = 1 - \frac{a^2}{k^2} \Rightarrow k = \frac{a^2}{b}$ .......(i)

Also $ke = b$ ........(ii)

From equation (i) and (ii) $e = \frac{b^2}{a^2}$

Since $e^2 = 1 - \frac{b^2}{a^2} \Rightarrow e^2 = 1 - e$

$\Rightarrow e^2 + e - 1 = 0$

(1) [e, $e^2$] (2) [0, e] (3) [e, $\ell$n2] (4) [0, $\ell$n2]

**Ans.** (4)

**Sol.** $[e^x]^2 + [e^x+1] - 3 = 0$

$[e^x]^2 + [e^x] - 2 = 0$

Let $[e^x] = t$





$t^2 + t - 2 = 0$

$(t+2)(t-1) = 0$

$t = 1, -2$

$[e^x]$ : 1, –2 (–2 is not possible)

$[e^x] = 1$

$x \in [0, \ell n2]$

**16.** Evaluates $\int \frac{e^x(2-x^2)}{(1-x)\sqrt{1-x^2}}dx$

(1) $e^x\sqrt{\frac{1+x}{1-2x}}+C$ (2) $e^x\sqrt{\frac{1+x}{1-x}}+C$ (3) $e^x\sqrt{\frac{1-x}{1+x}}+C$ (4) $e^x\left(\frac{1+x}{1-x}\right)+C$

**Ans.** (2)

**16.** Evaluates $\int \frac{e^x(2-x^2)}{(1-x)\sqrt{1-x^2}}dx$

(1) $e^x\sqrt{\frac{1+x}{1-2x}}+C$ (2) $e^x\sqrt{\frac{1+x}{1-x}}+C$ (3) $e^x\sqrt{\frac{1-x}{1+x}}+C$ (4) $e^x\left(\frac{1+x}{1-x}\right)+C$

**Ans.** (2)

**Sol.** $I = \int \frac{e^x(2-x^2)}{(1-x)\sqrt{1-x^2}}dx$

$= \int e^x\left\{\frac{1}{(1-x)^{3/2}(1+x)^{1/2}}+\left(\frac{1+x}{1-x}\right)^{\frac{1}{2}}\right\}dx$

$f(x) = \left(\frac{1+x}{1-x}\right)^{\frac{1}{2}} \Rightarrow f'(x) = \frac{1}{(1-x)^{3/2}(1+x)^{1/2}}$

$\Rightarrow I = \int e^x(f'(x)+f(x))dx$

$= e^x f(x) + C = e^x\sqrt{\frac{1+x}{1-x}}+C$

**17.** Four dice are rolled and the outcomes are put in 2 × 2 matrices. Find the probability that such a matrix will be non singular and all its entries are different.

(1) $\frac{71}{81}$ (2) $\frac{80}{81}$ (3) $\frac{30}{71}$ (4) $\frac{25}{71}$

**Ans.** (2)

**Sol.** $X = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$

$|x| = ad - bc = 0$

$\left.\begin{matrix}(1,6) & (3,2) \\ (3,4) & (62)\end{matrix}\right\} 8+8 \text{ possibilites}$

Required probability $= 1 - \frac{16}{6^4} = \frac{80}{81}$

**17.** Four dice are rolled and the outcomes are put in 2 × 2 matrices. Find the probability that such a matrix will be non singular and all its entries are different.

(1) $\frac{71}{81}$ (2) $\frac{80}{81}$ (3) $\frac{30}{71}$ (4) $\frac{25}{71}$

**Ans.** **(2)**

**Sol.** $X = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$

$|x| = ad - bc = 0$

$\left.\begin{matrix} (1,6) & (3,2) \\ (3,4) & (6,2) \end{matrix}\right\} 8 + 8$ possibilities

Required probability $= 1 - \frac{16}{6^4} = \frac{80}{81}$





**18.** Find the values of λ & μ for which the system of equations

$x + y + z = 6$

$3x + 5y + 5z = 26$

$x + 2y + \lambda z = \mu$ has no solution

**18.** Find the values of $\lambda$ & $\mu$ for which the system of equations

$x + y + z = 6$

$3x + 5y + 5z = 26$

$x + 2y + \lambda z = \mu$ has no solution

(1) $\lambda = 2, \mu \neq 10$ (2) $\lambda \neq 2, \mu = 10$ (3) $\lambda \neq 3, \mu = 10$ (4) $\lambda \neq 2, \mu \neq 10$

**Ans.** (1)

**Sol.** For no solution $\Delta = 0$

$\Delta = 0$

$$\begin{vmatrix} 1 & 1 & 1 \\ 3 & 5 & 5 \\ 1 & 2 & \lambda \end{vmatrix} = 0$$

$\Rightarrow 1(5\lambda - 10) - 1(3\lambda - 5) + 1(6 - 5) = 0$

$\Rightarrow 2\lambda - 4 = 0$

$\Rightarrow \lambda = 2$

$$\Delta_1 = \begin{vmatrix} 6 & 1 & 1 \\ 26 & 5 & 5 \\ \mu & 2 & 2 \end{vmatrix} = 0$$

$$\Delta_2 = \begin{vmatrix} 1 & 6 & 1 \\ 3 & 26 & 5 \\ 1 & \mu & 2 \end{vmatrix} = 1(52 - 5\mu) - 6(6 - 5) + 1(3\mu - 26)$$

$= 52 - 5\mu - 6 + 3\mu - 26$

$\Delta_2 = 20 - 2\mu$

$$\Delta_3 = \begin{vmatrix} 1 & 1 & 6 \\ 3 & 5 & 26 \\ 1 & 2 & \mu \end{vmatrix} = 1(5\mu - 52) - 1(3\mu - 26) + 6(6 - 5)$$

$\Delta_3 = 2\mu - 20$

**Case-I**

$\lambda = 2, \mu = 10 \Rightarrow \Delta = 0, \Delta_1 = 0, \Delta_2 = 0, \Delta_3 = 0$

$$\Delta_1 = \begin{vmatrix} \cdots \\ \mu & 2 & 2 \end{vmatrix}$$

$$\Delta_2 = \begin{vmatrix} 1 & 6 & 1 \\ 3 & 26 & 5 \\ 1 & \mu & 2 \end{vmatrix} = 1(52 - 5\mu) - 6(6 - 5) + 1(3\mu - 26)$$

$= 52 - 5\mu - 6 + 3\mu - 26$

$\Delta_2 = 20 - 2\mu$

$$\Delta_3 = \begin{vmatrix} 1 & 1 & 6 \\ 3 & 5 & 26 \\ 1 & 2 & \mu \end{vmatrix} = 1(5\mu - 52) - 1(3\mu - 26) + 6(6 - 5)$$

$\Delta_3 = 2\mu - 20$

**Case-I**

$\lambda = 2, \mu = 10 \Rightarrow \Delta = 0, \Delta_1 = 0, \Delta_2 = 0, \Delta_3 = 0$

system of equations are

$x + y + z = 6$

$3x + 5y + 5z = 26$

$x + 2y + 2z = 10$ has infinite many solutions

**Case - II**

$\lambda = 2, \mu \neq 10 \Rightarrow \Delta = 0, \Delta_1 = 0, \Delta_2 \neq 0, \Delta_3 \neq 0$

system has not solution

**19.** The number of elements in the set $\{x \in R : (|x| - 3)\,|x - 4| = 6\}$ is equal to

(1) 3 (2) 4 (3) 2 (4) 1

**Ans.** **(3)**

**Sol.** $(|x| - 3)\,|x - 4| = 6$

**Case - 1**

$x \geq 4$

$(x - 3)(x - 4) = 6$

$x^2 - 7x + 6 = 0$

$(x - 1)(x - 6) = 0$

$x = 1, 6 \Rightarrow x = 6$

**Case – 2**

$0 < x < 4$

$(x - 3)(4 - x) = 6$

$x^2 - 7x + 18 = 0$

$D < 0$, No solution

**Case -3**

$x \leq 0$

$(-x - 3)(4 - x) = 6$

$(x + 3)(x - 4) = 6$

$x^2 - x - 18 = 0$

$x = \dfrac{1 \pm \sqrt{73}}{2}$

$x = \dfrac{1 - \sqrt{73}}{2}$

**20.** If $\displaystyle\int_0^{100\pi} \frac{\sin^2 x}{e^{\left(\frac{x}{\pi} - \left[\frac{x}{\pi}\right]\right)}}\,dx = \frac{\alpha\pi^3}{1 + 4\pi^2}$, $\alpha \in R$ where [x] is greatest integer function, then $\alpha$ is

$$x = \frac{1-\sqrt{73}}{2}$$

**20.** If $\int_0^{100\pi} \frac{\sin^2 x}{e^{\left(\frac{x}{\pi}-\left[\frac{x}{\pi}\right]\right)}} dx = \frac{\alpha\pi^3}{1+4\pi^2}$, $\alpha \in R$ where [x] is greatest integer function, then $\alpha$ is

(1) $50(e-1)$ (2) $150(e^{-1}-1)$ (3) $200(1-e^{-1})$ (4) $100(1-e)$

**Ans.** **(3)**

**Sol.** $\int_0^{100\pi} \frac{\sin^2 x}{e^{\left\{\frac{x}{\pi}\right\}}} dx$

$\Rightarrow 100\int_0^{\pi} \frac{\sin^2 x}{e^{x/\pi}} dx$

$\Rightarrow 50\int_0^{\pi} e^{-x/\pi}[1-\cos 2x]dx$





$\Rightarrow 50\left[e^{-x/\pi} \times (-\pi)\right]_0^{\pi} - 50\int_0^{\pi} e^{-x/\pi}\cos 2x dx$

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$$\Rightarrow 50\left[e^{-x/\pi}\times(-\pi)\right]_0^{\pi} - 50\int_0^{\pi} e^{-x/\pi}\cos 2x\,dx$$

$$\Rightarrow 50\times(-\pi)(e^{-1}-1) - \frac{50\times\left[e^{-x/\pi}\left(\frac{-1}{\pi}\times\cos 2x + 2\sin 2x\right)\right]_0^{\pi}}{\left(\frac{1}{\pi^2}+4\right)}$$

$$\Rightarrow -50\pi(e^{-1}-1) - \frac{50\pi^2}{(1+4\pi^2)}\left[e^{-1}\left(\frac{-1}{\pi}\right)+\frac{1}{\pi}\right]$$

$$\Rightarrow \frac{200\pi^3(1-e^{-1})}{1+4\pi^2}$$ So $\alpha = 200(1-e^{-1})$





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