

हमारा विश्वास... हर एक विद्यार्थी है खास

**JEE
MAIN
Sept.
2020**

QUESTION PAPER WITH SOLUTION

MATHEMATICS _ 5 Sep. _ SHIFT - 1



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Q.1 If the volume of a parallelepiped, whose coterminus edges are given by the vectors

$$\vec{a} = \hat{i} + \hat{j} + n\hat{k}, \quad \vec{b} = 2\hat{i} + 4\hat{j} - n\hat{k} \text{ and } \vec{c} = \hat{i} + n\hat{j} + 3\hat{k} \quad (n \geq 0), \text{ is } 158 \text{ cu. units, then:}$$

यदि एक समांतर षट्फलक, जिसकी आसन्न भुजाएँ, सदिशों $\vec{a} = \hat{i} + \hat{j} + n\hat{k}$, $\vec{b} = 2\hat{i} + 4\hat{j} - n\hat{k}$ तथा $\vec{c} = \hat{i} + n\hat{j} + 3\hat{k}$ ($n \geq 0$), द्वारा दी गई है, का आयतन 158 घन इकाई है, तो

- (1) $\vec{a} \cdot \vec{c} = 17$ (2) $\vec{b} \cdot \vec{c} = 10$ (3) $n = 9$ (4) $n = 7$

Sol. 2

$$\begin{vmatrix} 1 & 1 & n \\ 2 & 4 & -n \\ 1 & n & 3 \end{vmatrix} = 158$$

$$(12 + n^2) - (6 + n) + n(2n - 4) = 158$$

$$3n^2 - 5n + 6 - 158 = 0$$

$$3n^2 - 5n - 152 = 0$$

$$3n^2 - 24n + 19n - 152 = 0$$

$$(3n + 19)(n - 8) = 0$$

$$\Rightarrow n = 8$$

$$\Rightarrow \vec{b} \cdot \vec{c} = 10$$

Q.2 A survey shows that 73% of the persons working in an office like coffee, whereas 65% like tea. If x denotes the percentage of them, who like both coffee and tea, then x cannot be:

एक सर्वेक्षण यह दिखाता है कि एक कार्यालय में कार्यरत 73% व्यक्ति कॉफी पसन्द करते हैं, जबकि 65% चाय पसन्द करते हैं। यदि x उस प्रतिशत को दर्शाता है, जो कॉफी और चाय दोनों को पसन्द करते हैं तो x नहीं हो सकता:

- (1) 63 (2) 54 (3) 38 (4) 36

Sol. 4

$$n(\text{coffee}) = \frac{73}{100}$$

$$n(\text{tea}) = \frac{65}{100}$$

$$n(T \cap C) = \frac{x}{100}$$

$$n(C \cup T) = n(C) + n(T) - x \leq 100$$

$$= 73 + 65 - x \leq 100$$

$$\Rightarrow x \geq 38$$

Ans. 36

Q.3 The mean and variance of 7 observations are 8 and 16, respectively. If five observations are 2, 4, 10, 12, 14, then the absolute difference of the remaining two observations is:

7 प्रेक्षणों का माध्य तथा प्रसरण क्रमशः 8 तथा 16 हैं। यदि पाँच प्रेक्षण 2, 4, 10, 12, 14 है, तो शेष दो प्रेक्षणों का निरपेक्ष अंतर है:

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

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Sol. 4

$$\text{Var}(x) = \sum \frac{x_i^2}{n} - (\bar{x})^2$$

$$16 = \frac{x_1^2 + x_2^2 + x_4^2 + x_5^2 + x_6^2 + x_7^2}{7} - 64$$

$$80 \times 7 = x_1^2 + x_2^2 + x_3^2 + \dots + x_7^2$$

$$\text{Now, } x_2^2 + x_7^2 = 560 - (x_1^2 + \dots + x_3^2)$$

$$x_6^2 + x_7^2 = 560 - (4 + 16 + 100 + 144 + 196)$$

$$x_6^2 + x_7^2 = 100 \quad \dots\dots(1)$$

$$\text{Now, } \frac{x_1 + x_2 + \dots + x_7}{7} = 8$$

$$x_6 + x_7 = 14 \quad \dots\dots(2)$$

from (1) & (2)

$$(x_6 + x_7)^2 - 2x_6x_7 = 100$$

$$2x_6x_7 = 96 \quad \Rightarrow x_6x_7 = 48 \quad \dots\dots(3)$$

$$\text{Now, } |x_6 - x_7| = \sqrt{(x_6 + x_7)^2 - 4x_6x_7}$$

$$= \sqrt{196 - 192} = 2$$

Q.4 If $2^{10} + 2^9 \cdot 3^1 + 2^8 \cdot 3^2 + \dots + 2 \cdot 3^9 + 3^{10} = S - 2^{11}$, then S is equal to:
यदि $2^{10} + 2^9 \cdot 3^1 + 2^8 \cdot 3^2 + \dots + 2 \cdot 3^9 + 3^{10} = S - 2^{11}$, तो S बराबर है:

- (1) 3^{11} (2) $\frac{3^{11}}{2} + 2^{10}$ (3) $2 \cdot 3^{11}$ (4) $3^{11} - 2^{12}$

Sol. 1

let

$$S' = 2^{10} + 2^9 \cdot 3^1 + 2^8 \cdot 3^2 + \dots + 2 \cdot 3^9 + 3^{10}$$

$$\frac{3 \times S'}{2} = 2^9 \times 3^1 + 2^8 \cdot 3^2 + \dots + 3^{10} + \frac{3^{11}}{2}$$

$$\frac{-S'}{2} = 2^{10} - \frac{3^{11}}{2}$$

$$S' = 3^{11} - 2^{11}$$

$$\text{Now } S' = S - 2^{11}$$

$$S = 3^{11}$$

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Q.5 If $3^{2 \sin 2\alpha - 1}$, 14 and $3^{4 - 2 \sin 2\alpha}$ are the first three terms of an A.P. for some α , then the sixth terms of this A.P. is:

यदि किसी α के लिए $3^{2 \sin 2\alpha - 1}$, 14 तथा $3^{4 - 2 \sin 2\alpha}$ एक समान्तर श्रेणी के प्रथम तीन पद हैं, तो इस समान्तर श्रेणी का छठा पद है:
 (1) 65 (2) 81 (3) 78 (4) 66

Sol. 4

$$28 = 3^{2 \sin 2\alpha - 1} + 3^{4 - 2 \sin 2\alpha}$$

$$28 = \frac{9^{\sin 2\alpha}}{3} + \frac{81}{9^{\sin 2\alpha}}$$

$$\text{Let } 9^{\sin 2\alpha} = t$$

$$28 = \frac{t}{3} + \frac{81}{t}$$

$$t^2 - 84t + 243 = 0$$

$$t = 81, 3$$

$$9^{\sin 2\alpha} = 9^2 \text{ or } 3$$

$$\sin 2\alpha = 2 \text{ or } \sin 2\alpha = 1/2$$

(Not possible)

Now three terms in A.P. are

1, 14, 27

Next term are

40, 53, 66

Q.6 If the common tangent to the parabolas, $y^2=4x$ and $x^2=4y$ also touches the circle, $x^2+y^2 = c^2$, then c is equal to:

यदि परवलयों $y^2=4x$ तथा $x^2=4y$ की उभयनिष्ठ स्पर्शरेखा, वृत्त $x^2+y^2 = c^2$, को भी स्पर्श करती है, तो c बराबर है:

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

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

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

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

Sol. 3

$$y = mx + \frac{1}{m}$$

$$x^2 = 4 \left(mx + \frac{1}{m} \right)$$

$$x^2 - 4mx - \frac{4}{m} = 0$$

$$D = 0$$

$$16m^2 + \frac{16}{m} = 0$$

$$16 \left(\frac{m^3 + 1}{m} \right) = 0$$

$$m = -1$$

$$\Rightarrow y + x = -1$$

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Now, $\left| \frac{-1}{\sqrt{2}} \right| = c$

$c = \frac{1}{\sqrt{2}}$

Q.7 If the minimum and the maximum values of the function $f : \left[\frac{\pi}{4}, \frac{\pi}{2} \right] \rightarrow \mathbb{R}$, defined by

$f(\theta) = \begin{vmatrix} -\sin^2 \theta & -1 - \sin^2 \theta & 1 \\ -\cos^2 \theta & -1 - \cos^2 \theta & 1 \\ 12 & 10 & -2 \end{vmatrix}$ are m and M respectively, then the ordered pair (m, M) is equal to :

यदि $f(\theta) = \begin{vmatrix} -\sin^2 \theta & -1 - \sin^2 \theta & 1 \\ -\cos^2 \theta & -1 - \cos^2 \theta & 1 \\ 12 & 10 & -2 \end{vmatrix}$ द्वारा परिभाषित फलन $f : \left[\frac{\pi}{4}, \frac{\pi}{2} \right] \rightarrow \mathbb{R}$, के निम्नतम तथा उच्चतम मान क्रमशः m

तथा M हैं, तो क्रमित युग्म (m, M) बराबर है:

- (1) $(0, 4)$
- (2) $(-4, 0)$
- (3) $(-4, 4)$
- (4) $(0, 2\sqrt{2})$

Sol. 2

$f(\theta) = \begin{vmatrix} -\sin^2 \theta & -1 - \sin^2 \theta & 1 \\ -\cos^2 \theta & -1 - \cos^2 \theta & 1 \\ 12 & 10 & -2 \end{vmatrix}$

$C_1 \rightarrow C_1 - C_2, C_3 \rightarrow C_3 + C_2$

$\begin{vmatrix} 1 & -1 - \sin^2 \theta & -\sin^2 \theta \\ 1 & -1 - \cos^2 \theta & -\cos^2 \theta \\ 2 & 10 & 8 \end{vmatrix}$

$C_2 \rightarrow C_2 - C_3$

$\begin{vmatrix} 1 & -1 & -\sin^2 \theta \\ 1 & -1 & -\cos^2 \theta \\ 2 & 2 & 8 \end{vmatrix}$

$1(2\cos^2\theta - 8) + (8 + 2\cos^2\theta) - 4\sin^2\theta$
 $f(\theta) = 4\cos 2\theta$

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Q.8 Let $\lambda \in \mathbb{R}$. The system of linear equations

$$2x_1 - 4x_2 + \lambda x_3 = 1$$

$$x_1 - 6x_2 + x_3 = 2$$

$$\lambda x_1 - 10x_2 + 4x_3 = 3$$

is inconsistent for:

- (1) exactly two values of λ
- (2) exactly one negative value of λ .
- (3) every value of λ .
- (4) exactly one positive value of λ .

माना $\lambda \in \mathbb{R}$. रेखिक समीकरण निकाय

$$2x_1 - 4x_2 + \lambda x_3 = 1$$

$$x_1 - 6x_2 + x_3 = 2$$

$$\lambda x_1 - 10x_2 + 4x_3 = 3$$

असंगत है:

- (1) λ के मात्र दो मानों के लिए।
- (2) λ के मात्र एक ऋणात्मक मान के लिए।
- (3) λ के प्रत्येक मान के लिए।
- (4) λ के मात्र एक धनात्मक मान के लिए।

Sol. 2

$$D = \begin{vmatrix} 2 & -4 & \lambda \\ 1 & -6 & 1 \\ \lambda & -10 & 4 \end{vmatrix} = 0$$

$$2(-14) + 4(4 - \lambda) + \lambda(6\lambda - 10) = 0$$

$$-28 + 16 - 4\lambda + 6\lambda^2 - 10\lambda = 0$$

$$6\lambda^2 - 14\lambda - 12 = 0$$

$$3\lambda^2 - 7\lambda - 6 = 0$$

$$3\lambda^2 - 9\lambda + 2\lambda - 6 = 0$$

$$(3\lambda + 2)(\lambda - 3) = 0$$

$$\lambda = -2/3, 3$$

$$D_1 = \begin{vmatrix} 1 & -4 & \lambda \\ 2 & -6 & 1 \\ 3 & -10 & 4 \end{vmatrix}$$

$$\Rightarrow -14 + 4(5) + \lambda(-2)$$


$$\Rightarrow -2\lambda + 6$$

$$D_2 = \begin{vmatrix} 2 & 1 & \lambda \\ 1 & 2 & 1 \\ \lambda & 3 & 4 \end{vmatrix}$$

$$\Rightarrow 2(5) - 1(4 - \lambda) + \lambda(3 - 2\lambda)$$

$$\Rightarrow 10 - 4 + \lambda + 3\lambda - 2\lambda^2$$

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$$\begin{aligned} &\Rightarrow -2\lambda^2 + 4\lambda + 6 \\ &\Rightarrow -2(\lambda^2 - 2\lambda - 3) \\ &\Rightarrow -2[\lambda^2 - 3\lambda + \lambda - 3] \\ &\Rightarrow -2(\lambda - 3)(\lambda + 1) \end{aligned}$$

$$D_3 = \begin{vmatrix} 2 & -4 & 1 \\ 1 & -6 & 2 \\ \lambda & -10 & 3 \end{vmatrix} \Rightarrow 2(-18 + 20) + 4(3 - 2\lambda) + 1(-10 + 6\lambda)$$

$$\begin{aligned} &= 4 + 12 - 8\lambda - 10 + 6\lambda \\ &= -2\lambda + 6 \\ &\Rightarrow \lambda = -2/3 \text{ is answer} \end{aligned}$$

- Q.9** If the point P on the curve, $4x^2 + 5y^2 = 20$ is farthest from the point Q(0, -4), then PQ^2 is equal to:
 यदि वक्र $4x^2 + 5y^2 = 20$ पर बिन्दु P, बिन्दु Q(0, -4) से अधिकतम दूरी पर है, तो PQ^2 बराबर है:

- (1) 48 (2) 29 (3) 21 (4) 36

Sol. 4

Let P be $(\sqrt{5} \cos \theta, 2 \sin \theta)$

$$\text{Now, } PQ = \sqrt{(\sqrt{5} \cos \theta)^2 + (2 \sin \theta + 4)^2}$$

$$PQ = \sqrt{5 \cos^2 \theta + (2 \sin \theta + 4)^2}$$

$$\frac{d(PQ)}{d\theta} = 0 \Rightarrow -10 \sin \theta \cos \theta + (4 \sin \theta + 8) \cos \theta = 0$$

$$\Rightarrow -6 \sin \theta \cos \theta + 8 \cos \theta = 0$$

$$\cos \theta = 0 \quad \text{or} \quad \sin \theta = \frac{4}{3}$$

Not possible

So P is either (0,2) or (0,-2)

$$PQ^2 = 36$$

- Q.10** The product of the roots of the equation $9x^2 - 18|x| + 5 = 0$ is :
 समीकरण $9x^2 - 18|x| + 5 = 0$ के मूलों का गुणनफल है:

- (1) $\frac{25}{81}$ (2) $\frac{5}{9}$ (3) $\frac{5}{27}$ (4) $\frac{25}{9}$

Sol. 1

$$9t^2 - 18t + 5 = 0$$

$$9t^2 - 15t - 3t + 5 = 0$$

$$(3t - 5)(3t - 1) = 0$$

$$|x| = \frac{5}{3}, \frac{1}{3}$$

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$$\Rightarrow x = \frac{5}{3}, \frac{-5}{3}, \frac{1}{3}, \frac{-1}{3}$$

$$\Rightarrow P = \frac{25}{81}$$

Q.11 If $y=y(x)$ is the solution of the differential equation $\frac{5+e^x}{2+y} \cdot \frac{dy}{dx} + e^x = 0$ satisfying $y(0)=1$, then a value of $y(\log_e 13)$ is:

यदि अवकल समीकरण $\frac{5+e^x}{2+y} \cdot \frac{dy}{dx} + e^x = 0$, का हल $y=y(x)$ है, जिसके लिए $y(0)=1$ है, तो $y(\log_e 13)$ का एक मान है:

(1) 1

(2) 0

(3) 2

(4) -1

Sol.

$$\frac{dy}{dx} + \left(e^x \times \frac{y+2}{e^x+5} \right) = 0$$

$$\frac{dy}{dx} + \left(\frac{e^x}{e^x+5} \right) y = \frac{-2e^x}{e^x+5}$$

$$\text{I.F.} = e^{\int \frac{-e^x}{e^x+5} dx}$$

$$= e^{\int \left(1 - \frac{5}{e^x+5} \right) dx}$$

$$= e^{\int \left(1 - \frac{5e^{-x}}{1+5e^{-x}} \right) dx}$$

$$= e^{x + \ln(1+5e^{-x})}$$

$$= e^x \cdot (1+5e^{-x}) \Rightarrow (e^x + 5)$$

$$y(e^x + 5) = -\int 2e^x dx$$

$$y(e^x + 5) = -2e^x + C$$

$$\downarrow x=0$$

$$(6) = -2 + C \Rightarrow C = 8$$

$$y(\ln 13) = \frac{8 - 2 \times 13}{13 + 5} = \frac{-18}{18} = -1$$

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Q.12 If S is the sum of the first 10 terms of the series $\tan^{-1}\left(\frac{1}{3}\right) + \tan^{-1}\left(\frac{1}{7}\right) + \tan^{-1}\left(\frac{1}{13}\right) + \tan^{-1}\left(\frac{1}{21}\right) + \dots$, then $\tan(S)$ is equal to :

यदि श्रेणी $\tan^{-1}\left(\frac{1}{3}\right) + \tan^{-1}\left(\frac{1}{7}\right) + \tan^{-1}\left(\frac{1}{13}\right) + \tan^{-1}\left(\frac{1}{21}\right) + \dots$, के प्रथम 10 पदों का योग S है, तो $\tan(S)$ बराबर है:

- (1) $\frac{5}{11}$ (2) $\frac{5}{6}$ (3) $-\frac{6}{5}$ (4) $\frac{10}{11}$

Sol. 2

$$S = \tan^{-1}\left(\frac{1}{1+1 \times 2}\right) + \tan^{-1}\left(\frac{1}{1+2 \times 3}\right) + \dots$$

$$T_r = \tan^{-1}\left(\frac{1}{1+r(r+1)}\right)$$

$$T_r = \tan^{-1}(r+1) - \tan^{-1}r$$

$$T_1 = \tan^{-1}2 - \tan^{-1}1$$

$$T_2 = \tan^{-1}3 - \tan^{-1}2$$

$$T_3 = \tan^{-1}4 - \tan^{-1}3$$

$$T_{10} = \tan^{-1}11 - \tan^{-1}10$$

$$\Rightarrow S = \tan^{-1}11 - \tan^{-1}1$$

$$\Rightarrow \tan S = \frac{10}{12} = \frac{5}{6}$$

Q.13 The value of $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \frac{1}{1+e^{\sin x}} dx$ is:

$$\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \frac{1}{1+e^{\sin x}} dx \text{ का मान है:}$$

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

Sol. 1

$$I = \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \frac{1}{1+e^{\sin x}} dx$$

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$$I = \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \frac{e^{\sin x}}{1 + e^{\sin x}} dx \Rightarrow 2I = \pi$$

$$I = \frac{\pi}{2}$$

Q.14 If (a, b, c) is the image of the point (1, 2, -3) in the line, $\frac{x+1}{2} = \frac{y-3}{-2} = \frac{z}{-1}$, then a+b+c is

यदि बिन्दु (1, 2, -3) का रेखा $\frac{x+1}{2} = \frac{y-3}{-2} = \frac{z}{-1}$, में प्रतिबिम्ब (a, b, c) है, तो (a+b+c) बराबर है:

(1) 2

(2) 3

(3) -1

(4) 1

Sol. 1

$$\overline{PM} \perp (2\hat{i} - 2\hat{j} - \hat{k})$$

$$\Rightarrow (2\lambda - 2) \cdot 2 + (1 - 2\lambda)(-2) + (3 - \lambda)(-1) = 0$$

$$\Rightarrow 4\lambda - 4 + 4\lambda - 2 + \lambda - 3 = 0$$

$$\Rightarrow 9\lambda = 9 \Rightarrow \lambda = 1$$

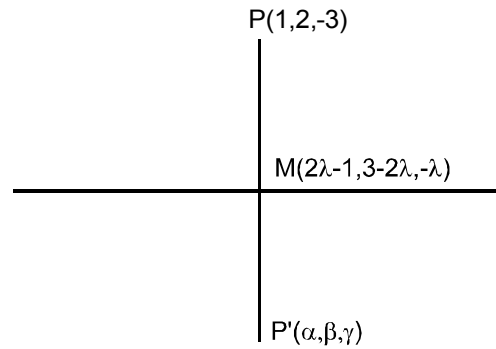
$$\Rightarrow m(1, 1, -1)$$

$$\text{Now, } p' = 2M - P$$

$$= 2(1, 1, -1) - (1, 2, -3)$$

$$= (1, 0, 1)$$

$$a + b + c = 2$$



Q.15 If the function $f(x) = \begin{cases} k_1(x - \pi)^2 - 1, & x \leq \pi \\ k_2 \cos x, & x > \pi \end{cases}$ is twice differentiable, then the ordered pair (k_1, k_2) is equal to:

यदि फलन $f(x) = \begin{cases} k_1(x - \pi)^2 - 1, & x \leq \pi \\ k_2 \cos x, & x > \pi \end{cases}$ द्वितीय अवकलनीय फलन है, तो क्रमित युग्म (k_1, k_2) बराबर है:

(1) (1, 1)

(2) (1, 0)

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

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

Sol. 4

$$f(x) = \begin{cases} 2k_1(x - \pi); & x \leq \pi \\ -k_2 \sin x & ; x > \pi \end{cases}$$

$$f''(x) = \begin{cases} 2k_1 & ; x \leq \pi \\ -k_2 \cos x; & x > \pi \end{cases}$$

$$2k_1 = k_2$$

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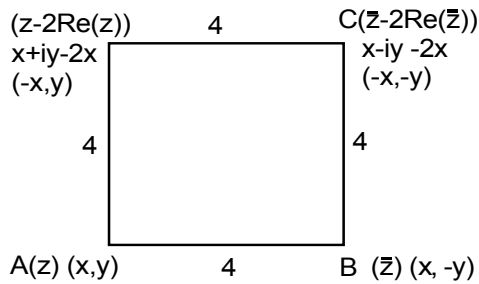
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Q.16 If the four complex numbers $z, \bar{z}, \bar{z}-2\text{Re}(\bar{z})$ and $z-2\text{Re}(z)$ represent the vertices of a square of side 4 units in the Argand plane, then $|z|$ is equal to:
 यदि आर्गंड तल में, चार सम्मिश्र संख्याएँ $z, \bar{z}, \bar{z}-2\text{Re}(\bar{z})$ तथा $z-2\text{Re}(z)$, 4 इकाई भुजा के एक वर्ग के शीर्षों को निरूपित करती हैं, तो $|z|$ बराबर है:

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

Sol. 4



Let $z = x + iy$
 $CA^2 = AB^2 + BC^2$
 $2^2x^2 + 2^2y^2 = 32$
 $x^2 + y^2 = 8$
 $\sqrt{x^2 + y^2} = 2\sqrt{2}$

Q.17 If $\int (e^{2x} + 2e^x - e^{-x} - 1)e^{(e^x+e^{-x})} dx = g(x)e^{(e^x+e^{-x})} + c$, where c is a constant of integration, then $g(0)$ is equal to :

यदि $\int (e^{2x} + 2e^x - e^{-x} - 1)e^{(e^x+e^{-x})} dx = g(x)e^{(e^x+e^{-x})} + c$, जहाँ c एक समाकलन अचर है, तो $g(0)$ बराबर है:

- (1) 2 (2) e (3) 1 (4) e^2

Sol. 1

$$\int (e^{2x} + 2e^x - e^{-x} - 1)e^{(e^x+e^{-x})} dx$$

$$\int (e^{2x} + e^x - 1)e^{(e^x+e^{-x})} dx + \int (e^x - e^{-x})e^{(e^x+e^{-x})} dx$$

$$\int (e^x + 1 - e^{-x})e^{(e^x+e^{-x}+x)} dx + \int (e^x - e^{-x})e^{(e^x+e^{-x})} dx$$

$$e^{(e^x+e^{-x}+x)} + e^{e^x+e^{-x}} + C$$

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$$(e^{e^x+e^{-x}})[e^x+1]+C$$

↓

$$g(x)$$

$$\Rightarrow g(0) = 2$$

Q.18 The negation of the Boolean expression $x \leftrightarrow \sim y$ is equivalent to :

बूले के व्यंजन $x \leftrightarrow \sim y$ का निषेधन निम्न में से किस के समतुल्य है?

(1) $(x \wedge y) \wedge (\sim x \vee \sim y)$

(2) $(x \wedge y) \vee (\sim x \wedge \sim y)$

(3) $(x \wedge \sim y) \vee (\sim x \wedge y)$

(4) $(\sim x \wedge y) \vee (\sim x \wedge \sim y)$

Sol. 2

As we know

$$\sim (p \leftrightarrow q) = (p \wedge \sim q) \vee (\sim p \wedge q)$$

$$\Rightarrow \text{so, } \sim (x \leftrightarrow \sim y) = (x \wedge y) \vee (\sim x \wedge \sim y)$$

Q.19 If α is positive root of the equation, $p(x) = x^2 - x - 2 = 0$, then $\lim_{x \rightarrow \alpha^+} \frac{\sqrt{1 - \cos(p(x))}}{x + \alpha - 4}$ is equal to :

यदि α समीकरण $p(x) = x^2 - x - 2 = 0$, का धनात्मक मूल है, तो $\lim_{x \rightarrow \alpha^+} \frac{\sqrt{1 - \cos(p(x))}}{x + \alpha - 4}$ बराबर है:

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

(2) $\frac{3}{\sqrt{2}}$

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

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

Sol. 2

$$f(x) = x^2 - x - 2 \left\langle_{-1}^2 = \alpha\right.$$

$$\lim_{x \rightarrow 2^+} \frac{\sqrt{1 - \cos(x-2)(x+1)}}{x + \alpha - 4}$$

$$\lim_{x \rightarrow 2^+} \frac{\sqrt{1 - \cos(x-2)(x+1)}}{(x-2)}$$

$$\lim_{h \rightarrow 0} \frac{\sqrt{1 - \cos(h \times (h+3))}}{h}$$

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$$\lim_{h \rightarrow 0} \sqrt{\frac{1 - \cos(h(h+3))}{h^2 \times (h+3)^2} \times (h+3)^2} \Rightarrow \sqrt{\frac{1}{2} \times 9} = \frac{3}{\sqrt{2}}$$

Q.20 If the co-ordinates of two points A and B are $(\sqrt{7}, 0)$ and $(-\sqrt{7}, 0)$ respectively and P is any point on the conic, $9x^2 + 16y^2 = 144$, then PA+PB is equal to :

यदि दो बिन्दुओं A तथा B के निर्देशांक क्रमशः $(\sqrt{7}, 0)$ तथा $(-\sqrt{7}, 0)$ है और शांकव $9x^2 + 16y^2 = 144$ पर कोई बिन्दु P है, तो

PA+PB बराबर है :

(1) 6

(2) 16

(3) 9

(4) 8

Sol. 4

$$\frac{x^2}{16} + \frac{y^2}{9} = 1$$

$$e = \sqrt{1 - \frac{9}{16}} = \frac{\sqrt{7}}{4}$$

$$F_1(\sqrt{7}, 0), F_2(-\sqrt{7}, 0)$$

$$PF_1 + PF_2 = 2a$$

$$PA + PB = 2 \times 4 = 8$$

Q.21 The natural number m, for which the coefficient of x in the binomial expansion of

$$\left(x^m + \frac{1}{x^2}\right)^{22} \text{ is 1540, is}$$

प्राकृत संख्या m, जिसके लिए $\left(x^m + \frac{1}{x^2}\right)^{22}$ के द्विपद प्रसार में x का गुणांक 1540 है, है.....

Sol. 13

$$T_{r+1} = {}^{22}C_r (x^m)^{22-r} \left(\frac{1}{x^2}\right)^r$$

$$= {}^{22}C_r (x)^{22m-mr-2r}$$

$$\text{Given } {}^{22}C_r = 1540 = {}^{22}C_{19} \Rightarrow r=19$$

$$\therefore 22m - rm - 2r = 1$$

$$\Rightarrow m = \frac{2r+1}{22-r}$$

$$m = 13 (\text{At } r=19)$$

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Q.22 Four fair dice are thrown independently 27 times. Then the expected number of times, at least two dice show up a three or a five, is

चार अनभिन्नत पासों को 27 बार स्वतंत्र रूप से फेंका जाता है। तो कम से कम दो पासों के तीन या पाँच दर्शाने की संभावना कितनी बार है?

Sol. 11

$$\begin{aligned} (\text{at least 2 or 3}) &= {}^4C_2 \left(\frac{2}{6}\right)^2 \left(\frac{4}{6}\right)^2 + {}^4C_3 \left(\frac{2}{6}\right)^3 \left(\frac{4}{6}\right)^1 + {}^4C_4 \left(\frac{2}{6}\right)^4 \\ &= 6 \times \frac{1}{9} \times \frac{4}{9} + 4 \times \frac{1}{27} \times \frac{2}{3} + \frac{1}{81} \\ &= \frac{33}{81} = \frac{11}{27} \Rightarrow nP \Rightarrow 11 \end{aligned}$$

Q.23 Let $f(x) = x \cdot \left[\frac{x}{2} \right]$, for $-10 < x < 10$, where $[t]$ denotes the greatest integer function. Then the number of points of discontinuity of f is equal to.....

माना $f(x) = x \cdot \left[\frac{x}{2} \right]$, $-10 < x < 10$, है जहाँ $[t]$ महत्तम पूर्णांक फलन है, तो f के असंतत बिन्दुओं की संख्या है.....

Sol. 8

$$f(x) = x \left[\frac{x}{2} \right], -10 < x < 10$$

$$-5 < \frac{x}{2} < 5$$

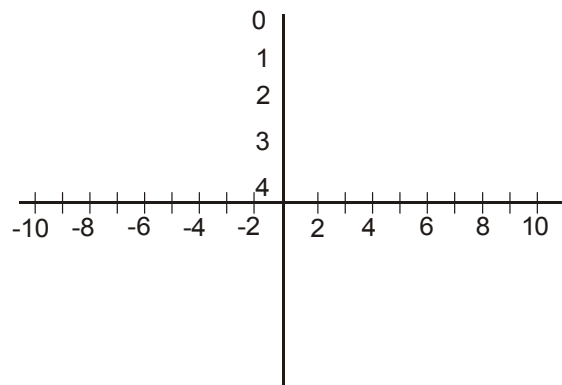
$$-5x \quad -5 < \frac{x}{2} < -4$$

$$-4x \quad -4 < \frac{x}{2} < -3$$

$$-3x \quad -3 < \frac{x}{2} < -2$$

$$-2x \quad -2 < \frac{x}{2} < -1$$

$$-x \quad -1 < \frac{x}{2} < 0$$



Number of point of discontinuity = 8

Q.24 The number of words, with or without meaning, that can be formed by taking 4 letters at a time from the letters of the word 'SYLLABUS' such that two letters are distinct and two letters are alike, is.

'SYLLABUS' शब्द के अक्षरों में से एक बार में 4 अक्षर लेकर बनाए जा सकने वाले शब्दों, अर्थपूर्ण या अर्थहीन, इस प्रकार कि दो अक्षर भिन्न हों तथा दो अक्षर एक समान हों, की संख्या है

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Sol. 240

SS, Y, LL, A, B, U

S S

$$\begin{aligned} &\Rightarrow {}^5C_2 \times \frac{4!}{2!} \times {}^2C_1 \\ &\Rightarrow 120 \times 2 \\ &= 240 \end{aligned}$$

Q.25 If the line, $2x-y+3=0$ is at a distance $\frac{1}{\sqrt{5}}$ and $\frac{2}{\sqrt{5}}$ from the lines $4x-2y+\alpha=0$ and $6x-3y+\beta=0$, respectively, then the sum of all possible values of α and β is

यदि रेखा $2x-y+3=0$ रेखाओं $4x-2y+\alpha=0$ तथा $6x-3y+\beta=0$ से क्रमशः $\frac{1}{\sqrt{5}}$ तथा $\frac{2}{\sqrt{5}}$ की दूरी पर है, तो α तथा β

के सभी सम्भव मानों का योगफल है।

Sol. 30

$$L_1 : 2x - y + 3 = 0$$

$$L_2 : 4x - 2y + \alpha = 0$$

$$L_3 : 6x - 3y + \beta = 0$$

$$\frac{\left| \frac{\alpha}{2} - 3 \right|}{\sqrt{5}} = \frac{1}{\sqrt{5}} \Rightarrow \frac{\alpha}{2} - 3 = 1, -1$$

$$\Rightarrow \alpha = 8, 4$$

$$\frac{\left| \frac{\beta}{3} - 3 \right|}{\sqrt{5}} = \frac{2}{\sqrt{5}} \Rightarrow \frac{\beta}{3} - 3 = 2, -2$$

$$\Rightarrow \beta = 15, 3$$

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