LIVE

JEE MAIN 2024

ATTEMPT – 01 , 27TH JAN 2024 , SHIFT - 02

PAPER DISCUSSION

Mathematics

Coefficient of x^{2012} in $(1-x)^{2008}(1+x+x^2)^{2007}$

(A) 0

(B) 1

(C) 2

(D) 3

$(1-x)\left[(1-x)(1+x+x^2)\right]^{2007}$

$(1-x)\,(1-x^3)^{2007}$

$\underbrace{(1-x^3)^{2007}}_{x^{2012}} - x\,\underbrace{(1-x^3)^{2007}}_{x^{2011}}$

$x^3 \rightarrow$ multiples

$0 \quad x^{3k}$

0

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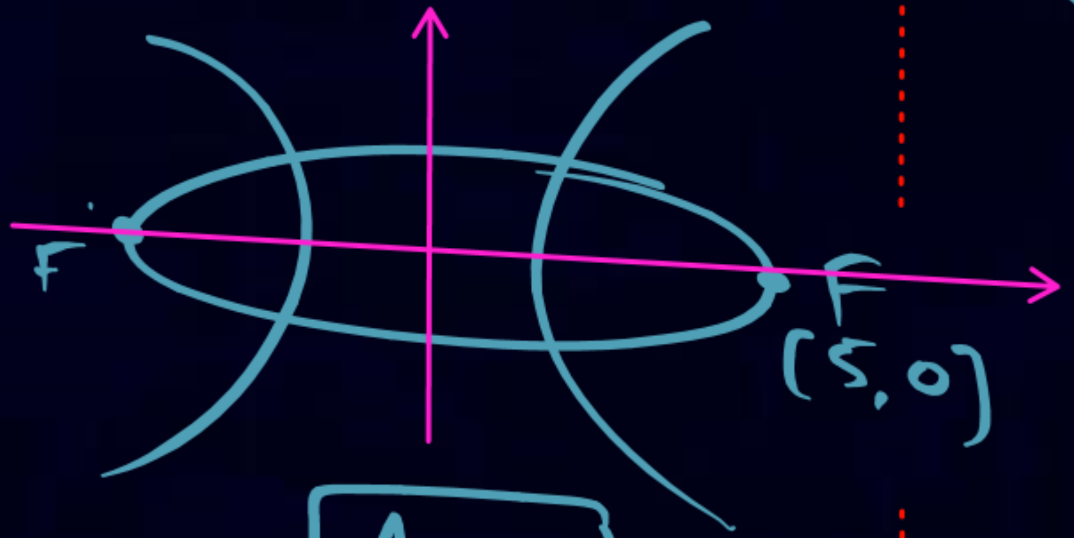
An ellipse is passing through foci of hyperbola $\boxed{\frac{x^2}{16} - \frac{y^2}{9} = 1}$ and product of their eccentricities is 1 then the length of chord of ellipse passing through (0, 2) and parallel to x-axis is

(A) $\frac{5\sqrt{5}}{3}$

(B) $\frac{3}{5\sqrt{5}}$

(C) $\frac{10\sqrt{5}}{3}$ ✓

(D) $\frac{20\sqrt{5}}{3}$



$\boxed{A = 5}$

$E = 4/5$

$B^2 = A^2(1 - E^2)$

$\boxed{B^2 = 9} = 25\left(1 - 16/25\right) = \cancel{25} \times 9/\cancel{25}$

F $(ae, 0)$

$a = 4$

$b = 3$

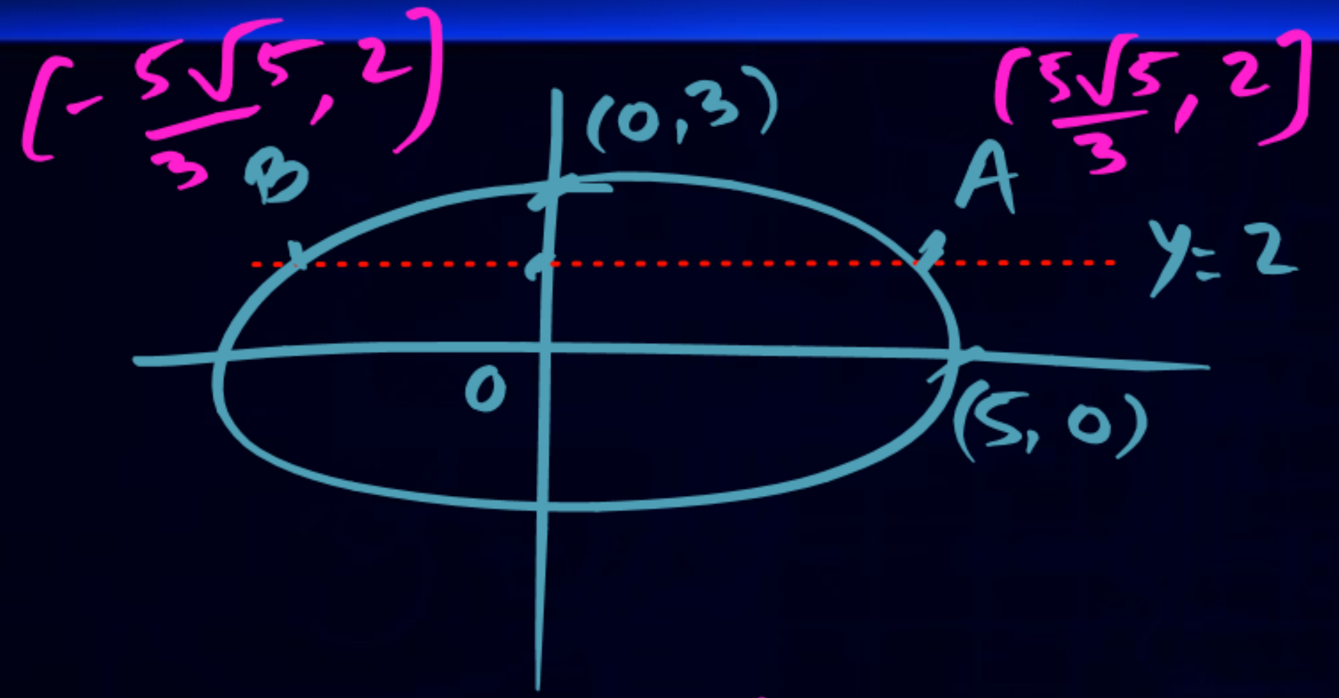
$a^2e^2 = a^2 + b^2$

$16e^2 = 4^2 + 3^2$

$e = 5/4$

F $\left[4 \times 5/4, 0\right]$

F $(5, 0)$



$$\frac{x^2}{25} + \frac{y^2}{9} = 1$$

Put $y = 2$

$$\frac{x^2}{25} + \frac{4}{9} = 1$$

$$\frac{x^2}{25} = \frac{5}{9}$$

$$x = \pm \frac{5\sqrt{5}}{3}$$

$$AB = 2 \times \frac{5\sqrt{5}}{3}$$

$$= \frac{10\sqrt{5}}{3}$$

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$\lim_{x\to 0} \frac{3 - a\sin x - b\cos x - \log_e(1+x)}{3\tan^2 x}$ is non zero finite find $2b - a$

$\frac{\tan^2 x}{x^2} \to 1$, x^2

(A) 2

(B) 5

(C) 7

(D) 9

$3 - b \to 0$

$\lim_{x\to 0} \left[\frac{3 - a\sin x - b\cos x - \ln(1+x)}{3x^2}\right]$

$\boxed{b = 3}$

$\lim_{x\to 0} \frac{3 - a\sin x - 3\cos x - \ln(1+x)}{3x^2}$

$\frac{-a\cos x + 3\sin x - \frac{1}{1+x}}{6x}$ $\to -a - \frac{1}{1} = 0$

$\boxed{a = -1}$

$2\times 3 - (-1)$

$= 7$

If $\underbrace{\tan^{-1} x}_{-ve} + \underbrace{\tan^{-1} 2x}_{-ve} = \frac{\pi}{4}$, then find number of solutions.

$$\tan^{-1}\left(\frac{x+2x}{1-x\cdot 2x}\right) = \pi/4$$

$$\tan^{-1}\left[\frac{3x}{1-2x^2}\right] = \pi/4$$

$$\frac{3x}{1-2x^2} = 1$$

$$3x = 1-2x^2$$

$$2x^2+3x-1=0$$

Ans 1

$$x = \frac{-3 \pm \sqrt{9+4\times 2}}{2\times 2}$$

$$= \frac{-3 \pm \sqrt{17}}{4}$$

$$\frac{-3+\sqrt{17}}{4}, \quad \frac{-3-\sqrt{17}}{4}$$

+ve $\quad$ $(-\pi/2, \pi/2)$

-ve.

Reject

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If $\lim_{x \to \frac{1}{\sqrt{2}}} \frac{\sin(\cos^{-1}x)-x}{1-\tan(\cos^{-1}x)} = \frac{-k}{\sqrt{2}}$, then the value of k is

(A) 2

(B) 1

(C) 1/2

(D) 1/4

$\boxed{\cos^{-1}x = \theta} \Rightarrow x = \cos\theta$

$$\lim_{\theta \to \pi/4} \frac{\sin\theta - \cos\theta}{1-\tan\theta} = \frac{\sin\theta - \cos\theta}{1 - \frac{\sin\theta}{\cos\theta}}$$

$$= \frac{\cancel{(\sin\theta - \cos\theta)}\cos\theta}{\cancel{(\cos\theta - \sin\theta)}}$$

$$\lim_{\theta \to \pi/4} -\cos\theta = \frac{-1}{\sqrt{2}}$$

$$\frac{-k}{\cancel{\sqrt{2}}} = \frac{-1}{\cancel{\sqrt{2}}}$$

$\boxed{k = 1}$

If 20^{th} term from the end of the progression

$20, 19\frac{1}{4}, 18\frac{1}{2}, 17\frac{3}{4}, \ldots, -129\frac{1}{4}$ is

$-3/4$ $-3/4$

(A) −120

(B) −115

(C) −125

(D) −110

$19-2/4$

$19-1/2$

$18-1/4$

$17\,3/4$

-115

$d = 3/4$

$a = -129\left(\frac{1}{4}\right)$

$T_{20} = a + 19d$

$= -129\left(\frac{1}{4}\right) + 19\left(\frac{3}{4}\right)$

$= -\left[129 + \frac{1}{4}\right] + \frac{57}{4}$

$= -129 - \frac{1}{4} + \frac{57}{4}$

$-129 + \frac{56}{4}$

$-129 + 14$

Difference of subsets of 2 finite sets with m & n elements, is 56 then find distance between (m, n) & (−2, −3).

(A) 10

(B) 16

(C) 14

(D) None of these

$(6,3)$ & $(-2,-3)$

$2^m - 2^n = 56$

$2^6 - 2^3 = 56$

$d^2 = 8^2 + 6^2$

$d = \sqrt{64+36}$

$= 10$

$m = 6$

$n = 3$

$2^3 = 8$

$2^4 = 16$

$2^5 = 32$

$2^6 = 64$

If α and $\frac{1}{\bar{\alpha}}$ are two complex numbers which satisfy the equations $|z - z_0|^2 = 4$ and $|z - z_0|^2 = 16$ respectively, where $z_0 = 1 + i$, then the value of $5|\alpha|^2$ is

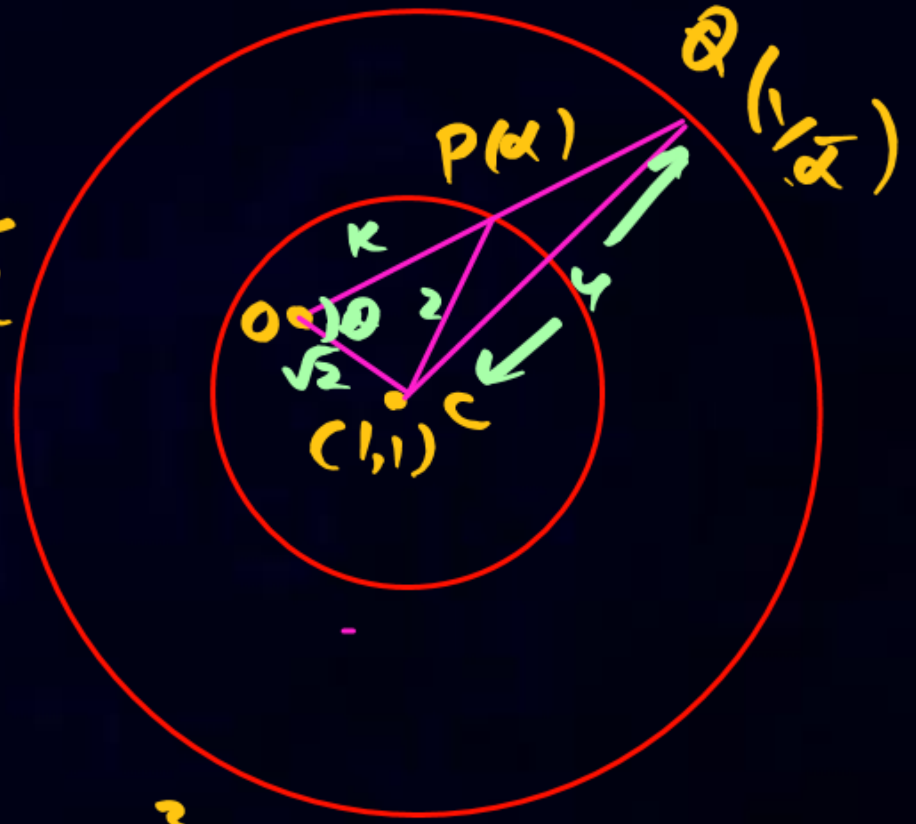
$\alpha\bar{\alpha} = |\alpha|^2$

$\frac{1}{\bar{\alpha}} = \frac{\alpha}{|\alpha|^2}$

$OP = |\alpha| = K$

$OQ = \left|\frac{1}{\bar{\alpha}}\right|$

$OQ = \frac{1}{|\alpha|} = \frac{1}{K}$



In ΔOPC

$\cos\theta = \frac{K^2 + 2 - 4}{2K\sqrt{2}} = \frac{K^2 - 2}{2\sqrt{2}K}$

In OQC

$\cos\theta = \frac{\frac{1}{K^2} + 2 - 4^2}{2\frac{1}{K}\cdot\sqrt{2}} = \frac{\frac{1}{K^2} - 14}{\frac{2\sqrt{2}}{K}}$

$(x-1)^2 + (y-1)^2 = 4$

$(x-1)^2 + (y-1)^2 = 16$

$$\frac{K^2-2}{\cancel{2\sqrt{2}}K} = \frac{\frac{1}{K^2}-14}{\cancel{2\sqrt{2}}\cdot\frac{1}{K}}$$

$$\frac{K^2-2}{\cancel{K}} = \frac{1-14K^2}{\cancel{K}}$$

$$K^2-2 = 1-14K^2$$

$$\boxed{15K^2=3}$$

$$15|\alpha|^2=3$$

$$|\alpha^2|=\frac{1}{5}$$

$$5|\alpha^2|=1$$

The integral $\int \frac{(x^8-x^2)}{(x^{12}+3x^6+1)\tan^{-1}\left(x^3+\frac{1}{x^3}\right)}dx$ is equal to:

(A) $\frac{1}{3}\ln\left|\left(\tan^{-1}\left(x^3+\frac{1}{x^3}\right)\right)\right|+C$

(B) $\ln\left|\left(\tan^{-1}\left(x^3+\frac{1}{x^3}\right)\right)\right|+C$

(C) $\frac{1}{6}\ln\left|\left(\tan^{-1}\left(x^3+\frac{1}{x^3}\right)\right)\right|+C$

(D) $\frac{1}{9}\ln\left|\left(\tan^{-1}\left(x^3+\frac{1}{x^3}\right)\right)\right|+C$

$$\frac{x^8-x^2}{x^6\left[x^6+3+\frac{1}{x^6}\right]\tan^{-1}\left(x^3+\frac{1}{x^3}\right)}$$

$$\int \frac{\left(x^2-\frac{1}{x^4}\right)dx}{\left(\left(x^3+\frac{1}{x^3}\right)^2+1\right)\tan^{-1}\left(x^3+\frac{1}{x^3}\right)}$$

$x^3+\frac{1}{x^3}=t$

$\left(3x^2-\frac{3}{x^4}\right)dx=dt$

$\left(x^2-\frac{1}{x^4}\right)dx=\frac{dt}{3}$

$$\frac{1}{3}\int \frac{dt}{(t^2+1)\tan^{-1}t}$$

$\tan^{-1}t=z$

$\frac{1}{1+t^2}dt=dz$

$$\frac{1}{3}\int\frac{dz}{z}=\frac{1}{3}\ln(\tan^{-1}t)+c$$

If $2\tan^2\theta - 5\sec\theta = 1$ has exactly 7 solutions in $\left[0, \frac{n\pi}{2}\right]$ for least value of $n \in N$, then $\sum_{k=1}^{n} \frac{k}{2^n}$ is equal to ________.

$n = 1 \quad [0, \pi/2]$

$\boxed{\cos\theta = 1/3}$

(A) $\frac{9}{2^9}$

(B) $\frac{91}{2^{13}}$

(C) $\frac{7}{2^7}$

(D) $\frac{11}{2^{12}}$

$\frac{1}{2^n} \sum_{K=1}^{n} K$

$\frac{1}{2^{13}}(1+2+\dots+13)$

$\frac{1}{2^{13}} \cdot \frac{13 \times 14}{2}$

$\frac{1}{2^{13}}(13 \times 7)$

$2(\sec^2\theta - 1) - 5\sec\theta = 1$

$\sec\theta = t$

$2t^2 - 2 - 5t = 1$

$2t^2 - 5t - 3 = 0$

$2t^2 - 6t + t - 3 = 0$

$(2t+1)(t-3) = 0$

$t = -\frac{1}{2}, \; t = 3$

$$\sum_{K=1}^{13} \frac{K}{2^K}$$

$$S = \frac{1}{2^1} + \frac{2}{2^2} + \frac{3}{2^3} + \cdots + \frac{13}{2^{13}}$$

$$\frac{S}{2} = \frac{1}{2^2} + \frac{2}{2^3} + \cdots + \frac{13}{2^{14}}$$

An urn contains 6 white and 9 black balls. Two successive draws of 4 balls are made without replacement. The probability that the first draw gives all white balls and second draw gives all black balls is:

(A) $\frac{2}{335}$

(B) $\frac{1}{495}$

(C) $\frac{5}{812}$

(D) ✓ $\frac{3}{715}$

$$= \frac{{}^{6}C_4}{{}^{15}C_4} \times \frac{{}^{9}C_4}{{}^{11}C_4}$$

6W
9B
→ 4 Balls

$$\frac{\cancel{15}}{\frac{\cancel{15} \times 14 \times 13 \times \cancel{12}}{\cancel{4} \times \cancel{3} \times 2}} \times \frac{\frac{\cancel{9 \times 8} \times 7 \times 6}{\cancel{4!}}}{\frac{11 \times 10 \times \cancel{9 \times 8}}{\cancel{4!}}}$$

$$\frac{1}{13 \times \cancel{7}} \times \frac{\cancel{7} \times 6}{11 \times 10} = \frac{3}{55 \times 13} = \frac{3}{715}$$

The vertices of a triangle are A(1, 2, 2), B(2, 1, 2) & C(2, 2, 1).
The perpendicular distance of its orthocentre from the given sides are ℓ_1, ℓ_2 & ℓ_3. Find the value of $\ell_1^2+\ell_2^2+\ell_3^2$. $= 3/6 = 1/2$

(A) 1

(B) $\frac{1}{2}$ ✓

(C) $\frac{1}{3}$

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

$x = \frac{1}{2}\frac{\sqrt{2}}{\sqrt{3}}$

$\boxed{x = \frac{1}{\sqrt{6}}}$

$AB = \sqrt{1^2+1^2} = \sqrt{2}$

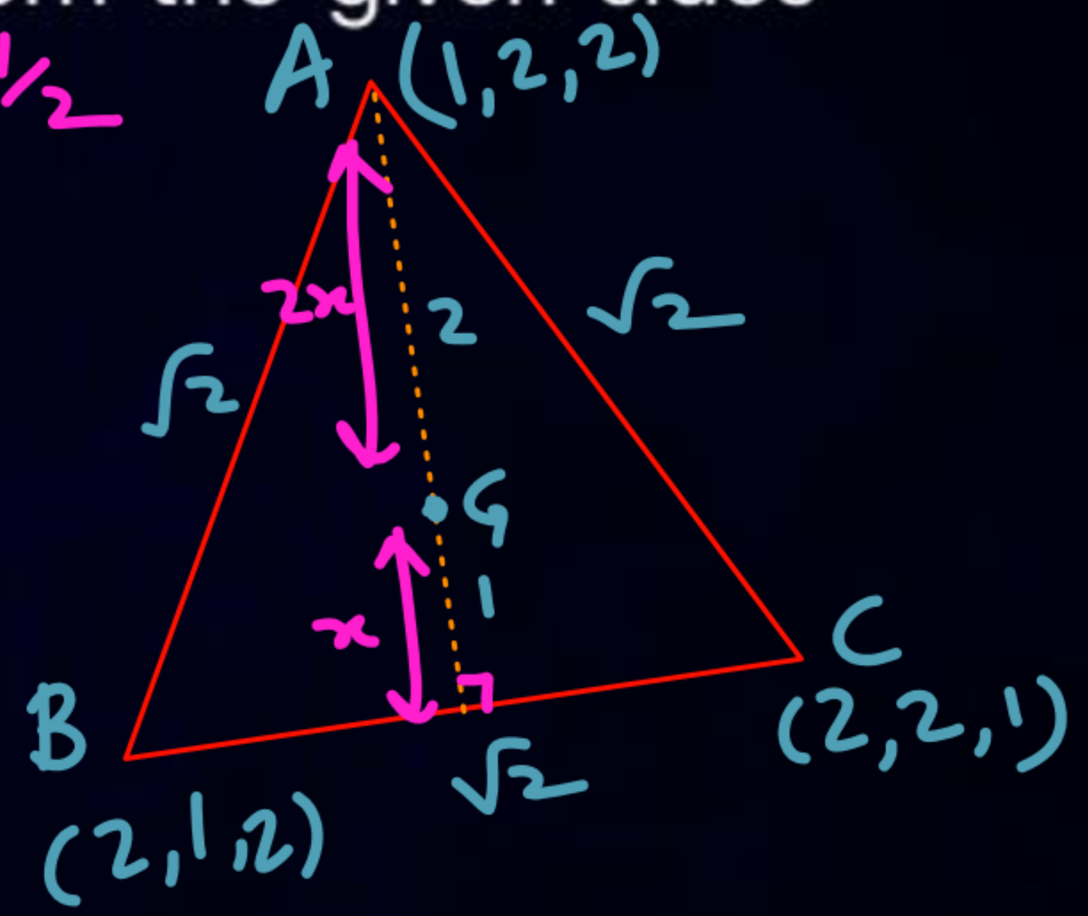
$BC = \sqrt{2}$

$AC = \sqrt{2}$

$G\left[5/3, 5/3, 5/3\right]$

$2x = AG$

$2x = \sqrt{(2/3)^2+(1/3)^2+(1/3)^2} = \sqrt{6/9} = \sqrt{2/3}$



If the mean of 15 observations are 12 and S.D is 3, But upon Rechecking we found that observation 12 was wrongly written as 10 if the new mean is μ and new variance is σ^2 then find the value of $15\left(\mu + \mu^2 + \sigma^2\right)$.

$$\frac{\Sigma x_i}{15} = 12$$

$$\Sigma x_i = 15 \times 12$$

$$\Sigma x_i = 180$$

$$\underset{\text{Correct}}{\Sigma x_i} = 180 - 10 + 12$$

Correct sum $= 182$

$$\mu = \frac{182}{15}$$

$$\frac{\Sigma x_i^2}{15}_{\text{old}} - (12)^2 = 9.$$

$$\frac{\Sigma x_i^2}{15} = 144 + 9$$

$$\Sigma x_i^2 = 153 \times 15$$

$$\underset{\text{Correct}}{\Sigma x_i^2} = 153 \times 15 - 10^2 + 12^2$$

$$= 153 \times 15 + 44$$

$$\sigma^2 = \frac{\Sigma x_i^2}{15} - (\mu)^2$$

$$\mu^2 + \sigma^2 = \frac{\Sigma x_i^2}{15}$$

$$\mu + \mu^2 + \sigma^2 = \frac{153 \times 15 + 44}{15} + \frac{182}{15}$$

Ans $= 153 \times 15 + 44 + 182$

Ans 2521

A is the area of region $0 \le y \le \min\left(\underbrace{2x, 6x - x^2}\right)$, then find 12A.

(A) 304 ✓

(B) 302

(C) 288

(D) 312

$y = 6x - x^2$

$\frac{dy}{dx} = 6 - 2x = 0$

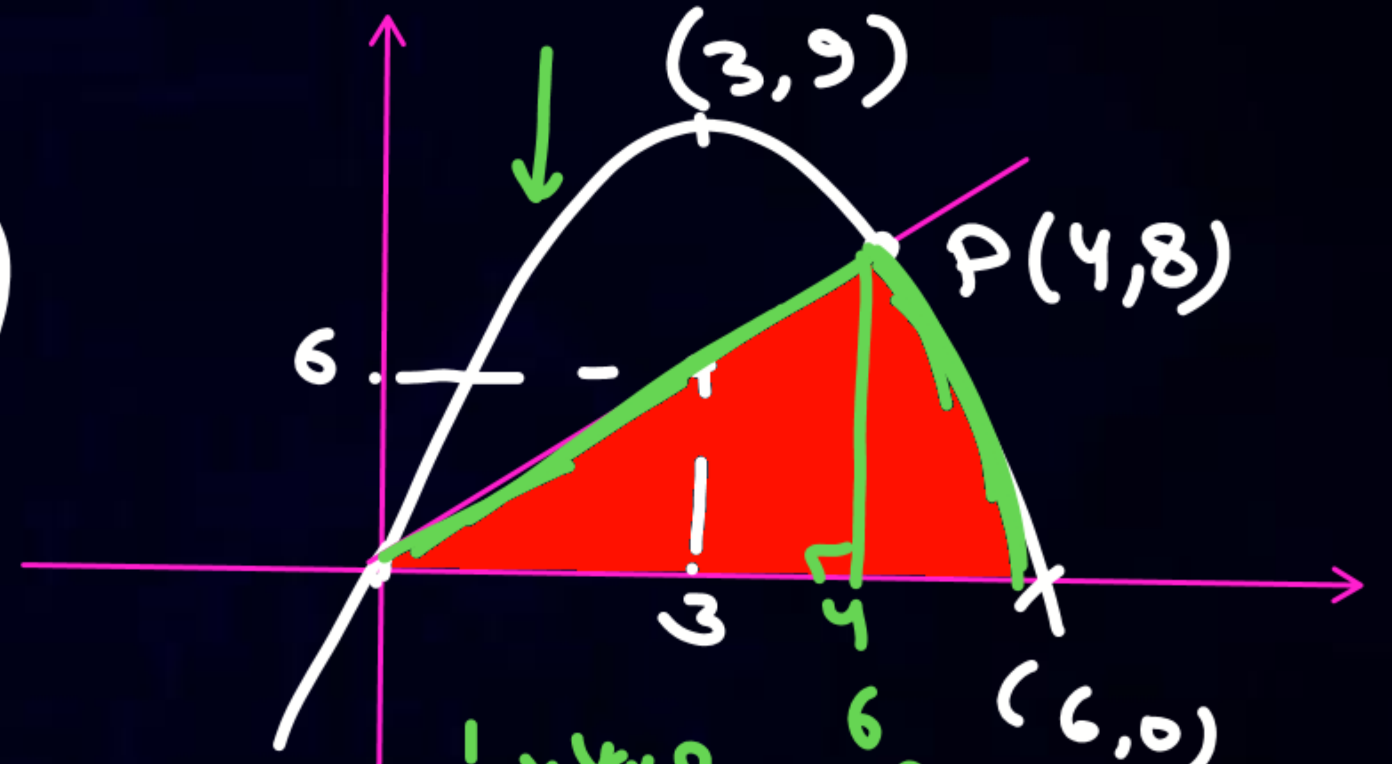
$x = 3$

$y = 6 \times 3 - 3^2$

$= 9$

$(3, 9)$

$y = 2x$



$\frac{1}{2} \times 4 \times 8 + \int_4^6 (6x - x^2)\,dx$

$6x - x^2 = 2x$

$4x = x^2$

$x = 4$

$16 + \int_4^6 (6x - x^2)\,dx$

$$16 + \int_4^6 (6x - x^2)\,dx$$

$$16 + 3x^2\Big|_4^6 - \frac{x^3}{3}\Big|_4^6$$

$$16 + 3(6^2 - 4^2) - \frac{(6^3 - 4^3)}{3}$$

$$16 + 3\times 20 - \left[\frac{216-64}{3}\right]$$

$$76 - \left[\frac{152}{3}\right]$$

$$A = 76/3$$

$$12A = 76\times 4$$
$$= 304$$

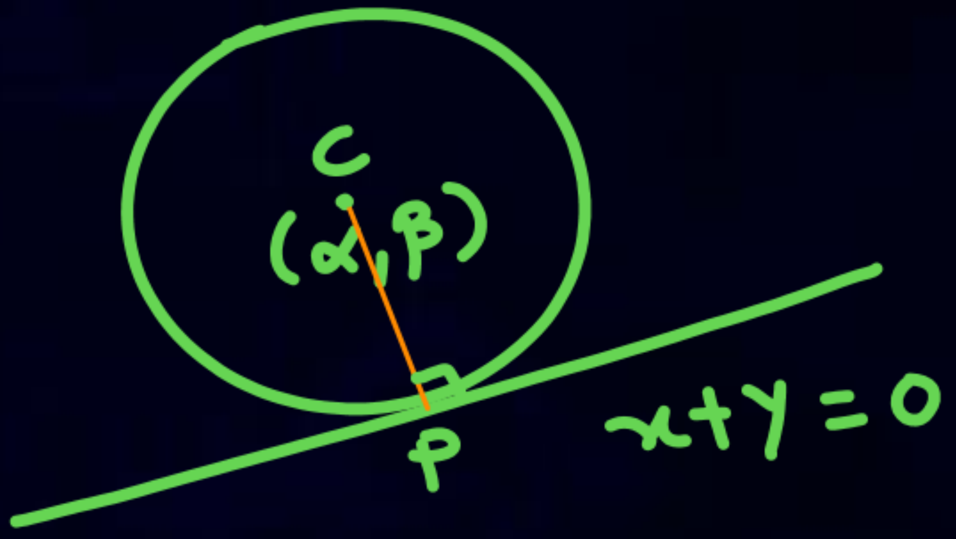
Equation of tangent to circle $(x-\alpha)^2+(y-\beta)^2=50$ is $x+y=0$. find $(\alpha+\beta)^2$.

$$CP = r$$

$$\left|\frac{\alpha+\beta}{\sqrt{2}}\right| = \sqrt{50}$$

$$|\alpha+\beta| = \sqrt{100}$$

$$|\alpha+\beta| = 10$$



$$r = \sqrt{50}$$

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There are four boxes A_1, A_2, A_3 and A_4. Box A_i has **i** cards and on each card a number is printed, the numbers are from 1 to **i**. A box is selected randomly, the probability of selection of box A_i is $\frac{i}{10}$ and then a card is drawn. Let E_i represents the event that a card with number 'i' is drawn. $P(A_3/E_2)$ is equal to:

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

(B) $\frac{1}{3}$

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

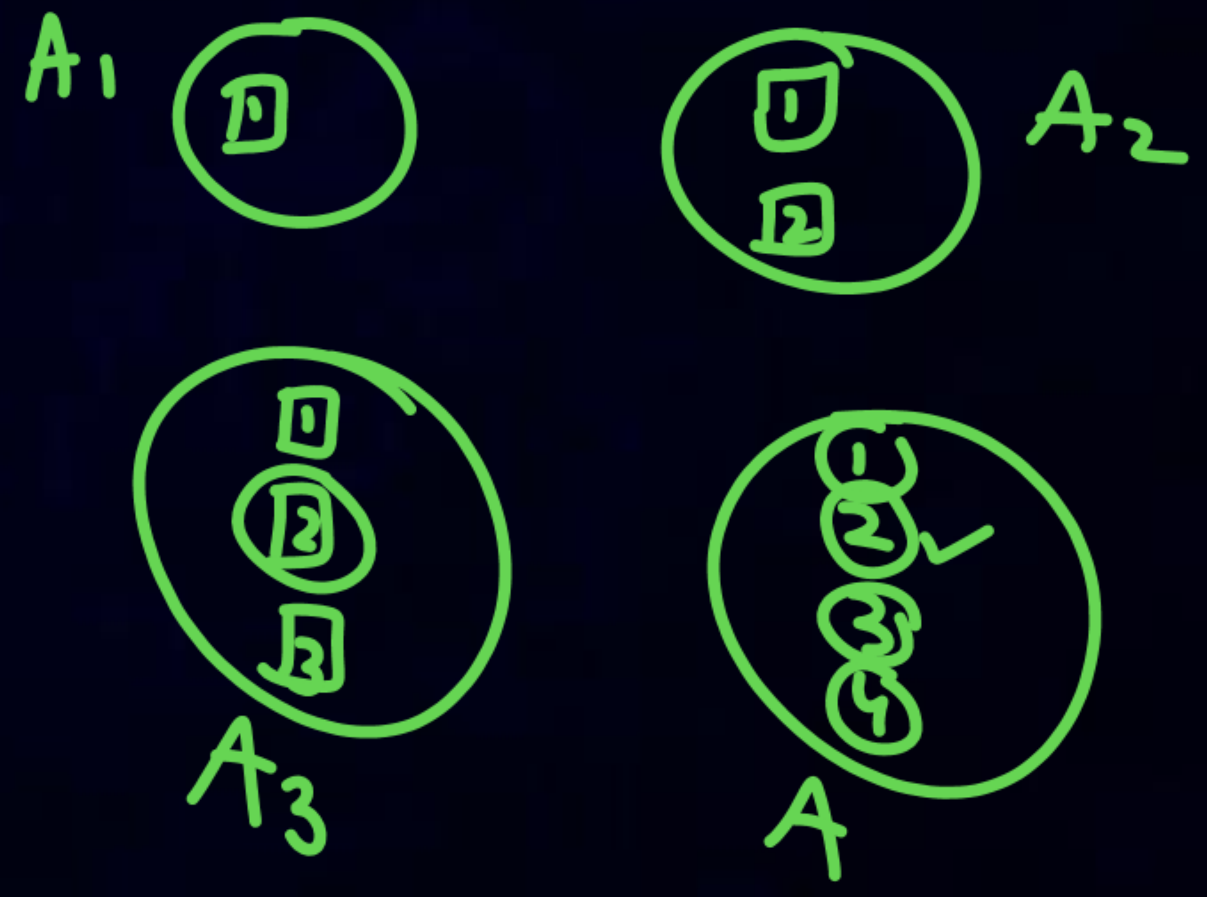
(D) $\frac{2}{3}$

$P(A_1) = \frac{1}{10}$

$P(A_2) = \frac{2}{10}$

$P(A_3) = \frac{3}{10}$

$P(A_4) = \frac{4}{10}$



$$P(A_3/E_2) = \frac{P(A_3 \cap E_2)}{P(E_2)}$$

$$P(E_2) = \frac{\cancel{2}}{10} \times \frac{1}{\cancel{2}} + \frac{\cancel{3}}{10} \cdot \frac{1}{\cancel{3}} + \frac{\cancel{4}}{10} \times \frac{1}{\cancel{4}}$$

$$= \frac{1}{10} + \frac{1}{10} + \frac{1}{10} = \frac{3}{10}$$

$$\frac{\frac{\cancel{3}}{10} \times \frac{1}{\cancel{3}}}{\frac{3}{10}} = \frac{1}{3}$$

If $\frac{dy}{dx} + xy = x^3y^3, y(0) = 1$, then $y(7)$ equals

(A) 1/50

(B) 50

(C) $1/\sqrt{50}$

(D) $\sqrt{50}$

$\frac{dy}{dx} + xy = x^3y^3$

$\frac{1}{y^3}\frac{dy}{dx} + \frac{x}{y^2} = x^3$

$\frac{1}{y^2} = t$

$-\frac{2}{y^3}\frac{dy}{dx} = \frac{dt}{dx}$

$\frac{1}{y^3}\frac{dy}{dx} = -\frac{1}{2}\frac{dt}{dx}$

$-\frac{1}{2}\frac{dt}{dx} + xt = x^3$

$\frac{dt}{dx} - 2xt = -2x^3$

$IF = e^{\int -2x\,dx} = e^{-x^2}$

$te^{-x^2} = \int -2x^3 e^{-x^2}\,dx$

$-x^2 = z$

$-2x\,dx = dz$

$= \int dz(-z)e^z$

$= -\int ze^z\,dz$

$= -[ze^z - e^z] + c$

$= -e^z(z-1) + c$

$$te^{-x^2} = -e^{z}(z-1) + c$$

$$\frac{1}{y^2}e^{-x^2} = -e^{-x^2}(-x^2-1) + c$$

$$\frac{e^{-x^2}}{y^2} = e^{-x^2}(x^2+1) + c$$

$$\boxed{\frac{1}{y^2} = x^2+1+ce^{x^2}}$$

$x=0,\ y=1$

$$y = 0+\cancel{1}+ce^{0}$$

$$\boxed{c=0}$$

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

$x=7$

$$\frac{1}{y^2} = 49+1$$

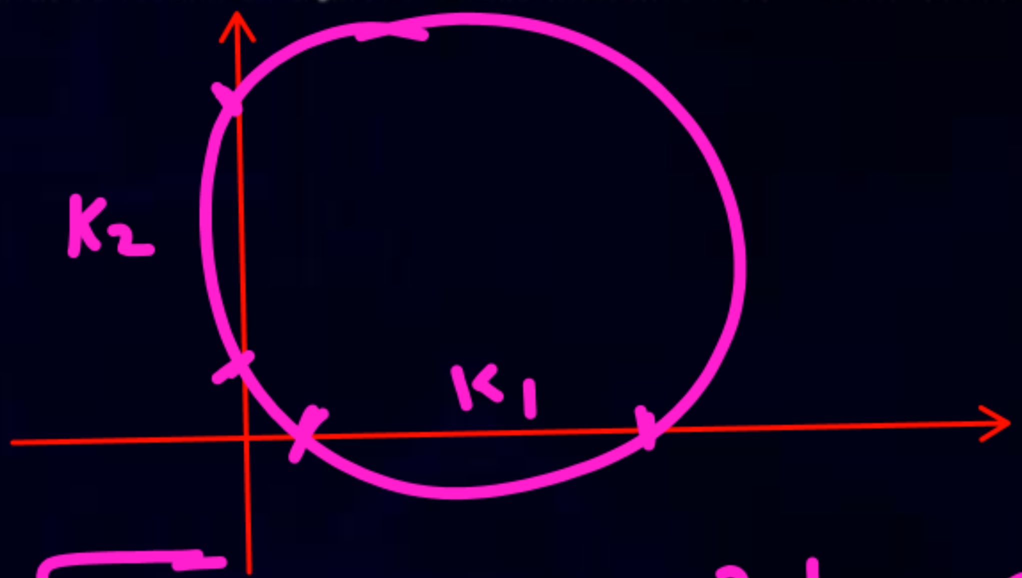
$$y^2 = \frac{1}{50}$$

$$y = \frac{1}{\sqrt{50}}$$

JEE MAIN 2024 LIVE PAPER DISCUSSION

A circle cuts two perpendicular lines so that intercept on each of the line is of given length.
The locus of the centre of circle

$-g = h$
$-f = k$



(A) a hyperbola of eccentricity 5/4

(B) a hyperbola of eccentricity $\sqrt{2}$

(C) an ellipse of eccentricity 4/5

(D) a parabola

$\boxed{x^2 - y^2 = c}$

$2\sqrt{g^2 - c} = k_1 \Rightarrow g^2 - c = \left(\frac{k_1}{2}\right)^2$

$2\sqrt{f^2 - c} = k_2 \qquad f^2 - c = \left(\frac{k_2}{2}\right)^2$

$g^2 - f^2 = \frac{k_1^2 - k_2^2}{4}$

$\boxed{h^2 - k^2 = c}$

If $\int \frac{\sin 2x}{\sin 3x \sin 5x} dx = \frac{1}{p}\log_e|\sin 3x| - \frac{1}{q}\log_e|\sin 5x| + C$, then $|p - q|$ is equal to (where C is constant of integration)

(A) 1

(B) 2

(C) 5

(D) 7

$$\int \frac{\sin(5x-3x)}{\sin 3x \sin 5x} dx$$

$$\frac{\sin 5x \cos 3x - \cos 5x \sin 3x}{\sin 3x \sin 5x}$$

$$\int \cot 3x - \int \cot 5x$$

$$\frac{\ln(\sin 3x)}{3} - \frac{\ln(\sin 5x)}{5}$$

$p = 3$

$q = 5$

If $a_n = \int_0^{\pi/2} \frac{\sin^2 nx}{\sin x} dx$, then $a_2 - a_1$, $a_3 - a_2$, $a_4 - a_3$ are in

(A) A.P

(B) G.P

(C) H.P ✓

(D) A.G.P

$$a_n = \int_0^{\pi/2} \frac{\sin^2 nx}{\sin x} dx \quad \text{(1)}$$

$$a_{n-1} = \int_0^{\pi/2} \frac{\sin^2 (n-1)x}{\sin x} dx \quad \text{(2)}$$

$$a_n - a_{n-1} = \int \frac{\left(\sin^2 nx - \sin^2 (n-1)x\right)}{\sin x} dx$$

$$\int_0^{\frac{\pi}{2}} \frac{\sin(2n-1)x \, \cancel{\sin x}}{\cancel{\sin x}} dx$$

$$= \left. \frac{-\cos(2n-1)x}{(2n-1)} \right|_0^{\pi/2}$$

$$= \frac{1 - \underbrace{\cos(2n-1)\pi/2}_{0}}{(2n-1)}$$

$$\Rightarrow \boxed{a_n - a_{n-1} = \frac{1}{2n-1}}$$

$$\left.\begin{aligned} a_2 - a_1 &= 1/3 \\ a_3 - a_2 &= 1/5 \\ a_4 - a_3 &= 1/7 \end{aligned}\right\}$$

A is a 2×2 matrix, I is 2×2 identity matrix. $|A - xI| = 0$ has the roots $-1, 3$. Then the sum of diagonal elements of A^2.

$$A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

$$xI = \begin{bmatrix} x & 0 \\ 0 & x \end{bmatrix}$$

$$A - xI = \begin{bmatrix} a-x & b \\ c & d-x \end{bmatrix}$$

$$|A - xI| = (a-x)(d-x) - bc$$

$$0 = ad + x^2 - (a+d)x - bc$$

$$x^2 - (\underbrace{a+d}_{\text{tr}A})x + \underbrace{ad-bc}_{|A|} = 0$$

$$x^2 - (\text{sum})x + \text{product} = 0$$

$$\text{sum} = (a+d) = 2$$

$$\text{product} = |A| = -3$$

$$A^2 - 2A - 3I = 0$$

$$A^2 = 2A + 3I$$

$$\text{tr}(A^2) = 2\,\text{tr}A + 3\,\text{tr}I \rightarrow 2$$

$$= 4 + 6$$

$0 < a < 1, \int_0^{\pi} \frac{dx}{1-2a\cos x+a^2}$ = value of the integral

(A) $\frac{\pi^2}{\pi+a^2}$

(B) $\frac{\pi}{1+a^2}$

(C) $\frac{\pi^2}{\pi-a^2}$

(D) $\frac{\pi}{1-a^2}$ ✓

$$I = \int_0^{\pi} \frac{dx}{1-2a\cos x+a^2} \rightarrow (1)$$

$x \rightarrow \pi - x$

$$I = \int_0^{\pi} \frac{dx}{1+2a\cos x+a^2} \rightarrow (2)$$

$$2I = \int_0^{\pi} \frac{1+\cancel{2a\cos x}+a^2+1-\cancel{2a\cos x}+a^2}{(1+a^2)^2-4a^2\cos^2 x}$$

$$\cancel{2}I = \int_0^{\pi} \frac{\cancel{2}(1+a^2)\,dx}{(1+a^2)^2-4a^2\cos^2 x}$$

$$I = 2\int_0^{\pi/2} \frac{(1+a^2)\,dx}{(1+a^2)^2-4a^2\cos^2 x}$$

$$I = 2\int_0^{\pi/2} \frac{(1+a^2)\sec^2 x\,dx}{(1+a^2)^2(1+\tan^2 x)-4a^2}$$

$$2(1+a^2)\int \frac{\sec^2 x\,dx}{(1+a^2)^2+(1+a^2)^2\tan^2 x-4a^2}$$

$$2(1+a^2)\int \frac{\sec^2 x\, dx}{(1-a^2)^2+(1+a^2)^2\tan^2 x} = \frac{2}{\cancel{1+a^2}}\cdot\frac{\cancel{(1+a^2)}}{1-a^2}\tan^{-1}\frac{t}{\frac{1-a^2}{1+a^2}}\Bigg|_0^\infty$$

$$\frac{2\cancel{(1+a^2)}}{(1+a^2)^{\cancel{2}}}\int \frac{\sec^2 x\, dx}{\frac{(1-a^2)^2}{(1+a^2)^2}+\tan^2 x} = \left(\frac{\cancel{2}}{1-a^2}\right)\cdot\frac{\pi}{\cancel{2}}$$

$$\tan x = t$$

$$\frac{2}{1+a^2}\int_0^\infty \frac{dt}{\left(\frac{1-a^2}{1+a^2}\right)^2+t^2}$$

For $x \in (0, 3)$

$g(x) = 3f\left(\frac{x}{3}\right) + f(3 - x)$ and $\boxed{f''(x) > 0}$ $\forall x \in (0,3)$,

f' is $\uparrow$

If $g(x)$ is increasing in $(\alpha, 3)$ and decreasing in $(0, \alpha)$ then find α.

$g'(x) = \cancel{3}f'(x/3)\cdot\frac{1}{\cancel{3}} + f'(3-x)(-1) > 0$

for $\uparrow$ $f'(x/3) - f'(3-x) > 0$

$\alpha = 9/4$

$f'(\underbrace{x/3}) > f'(\underbrace{3-x})$

$(\alpha, 3)$

$x/3 > 3-x$

$x > 9-3x$

$4x > 9$

$x > 9/4$

Let $f: R-\left\{-\frac{1}{2}\right\} \rightarrow R$ and $g: R-\left\{-\frac{5}{2}\right\} \rightarrow R$ be defined as $f(x)=\frac{2x+3}{2x+1}$ and $g(x)=\frac{|x|+1}{2x+5}$ then the domain of the function f(g(x)) is:

(A) R

(B) $R-\left\{-\frac{5}{2}\right\}$

(C) $R-\left\{-\frac{1}{2},-\frac{5}{2}\right\}$

(D) $R-\left\{-\frac{1}{2}\right\}$

$x \rightarrow g(x)$

$\boxed{x \neq -5/2}$

$f(g(x)) = \frac{2g(x)+3}{2g(x)+1}$

$\frac{|x|+1}{2x+5} = -\frac{1}{2}$

$2|x|+2 = -2x-5$

$x<0 \quad 2=-5$ ✗

$x>0 \quad 2x+2=-2x-5$

$4x=-7$

$x=-7/4$

$2g(x)+1 \neq 0$

$g(x) \neq -\frac{1}{2}$

Values of α for which $\begin{vmatrix} 1 & \frac{3}{2} & \alpha+\frac{3}{2} \\ 1 & \frac{1}{3} & \alpha+\frac{1}{3} \\ 2\alpha+3 & 3\alpha+1 & 0 \end{vmatrix} = 0$ lies in the interval

(A) (0, 3)

(B) (–3, 0)

(C) (–2, 1)

(D) (–2, 0)

$C_3 \to C_3 - C_2 - \alpha C_1$

$\begin{vmatrix} 1 & 3/2 & 0 \\ 1 & 1/3 & 0 \\ 2\alpha+3 & 3\alpha+1 & -(3\alpha+1)-\alpha(2\alpha+3) \end{vmatrix} = 0$

$-3\alpha-1-2\alpha^2-3\alpha$

$-2\alpha^2-6\alpha-1$

$-\cancel{\left(\frac{1}{3}-\frac{3}{2}\right)}(2\alpha^2+6\alpha+1) = 0$

$2\alpha^2+6\alpha+1=0$

$\alpha = \frac{-6 \pm \sqrt{36-8}}{2\times 2}$

$= \frac{-6 \pm \sqrt{28}}{2\times 2}$

$= \frac{-6 \pm 2\sqrt{7}}{2\times 2}$

$= \frac{-3 \pm \sqrt{7}}{2}$

#

If $\frac{dy}{dx}=\frac{x+y-2}{x-y}$, and $y(0)=2$, find $\underbrace{y(2)}$.

(A) 0 ✓

(B) 2

(C) e

(D) e^2

$$\frac{dy}{dx}=\frac{a_1x+b_1y+c_1}{a_2x+b_2y+c_2}$$

$X=x-1$

$Y=y-1$

$$\frac{dY}{dX}=\frac{X+Y}{X-Y} \qquad Y=VX$$

$$X\frac{dV}{dX}=\frac{1+V}{1-V}-V$$

$$X\frac{dV}{dX}=\frac{1+\cancel{V}-\cancel{V}+V^2}{1-V}$$

$$\int\frac{(1-V)}{1+V^2}dV=\int\frac{dX}{X}$$

$$\tan^{-1}V-\frac{1}{2}\ln(1+V^2)=\ln X+C$$

$$\tan^{-1}\left(\frac{y-1}{x-1}\right)-\frac{1}{2}\ln\left(1+\left(\frac{y-1}{x-1}\right)^2\right)=\ln|x-1|+C$$

$x=0,\ y=2$

$$\tan^{-1}(-1)-\frac{1}{2}\ln 2=0+C$$

$$C=-\pi/4-\frac{1}{2}\ln 2$$

$x = 2$ ✓

$$\tan^{-1}\left(\frac{y-1}{2-1}\right) - \frac{1}{2}\ln\left(1 + \left(\frac{y-1}{2-1}\right)^2\right) = -\frac{\pi}{4} - \frac{1}{2}\ln 2$$

$$\boxed{y = 0}$$

Let $(x^2 - 4)dy = y(y - 3)dx$ satisfying $y(4) = \frac{3}{2}$ then $y(10)$ is equal to

(A) $\frac{3}{1 - 8^{\frac{1}{4}}}$

(B) $\frac{3}{1 + 8^{\frac{1}{4}}}$

(C) $\frac{3}{1 + 2^{\frac{1}{4}}}$

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

$$\int \frac{dy}{y(y-3)} = \int \frac{dx}{x^2-4}$$

$$\frac{1}{3}\int \frac{y-(y-3)}{y(y-3)} = \frac{1}{2\times 2} \ln\left(\frac{x-2}{x+2}\right)$$

Let the image of the point $(1, a, 7)$ in the line $\frac{x}{1}=\frac{y-1}{2}=\frac{z-2}{3}$ be the point (α, β, γ) then which one of the following points lie on the line passing through (α, β, γ) then which making angles $\frac{\pi}{3}$ & $\frac{3\pi}{4}$ with y-axis and z axis respectively and an acute angle with x –axis?

(A) $(1,2,1-\sqrt{2})$

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

(C) $(3,-4,3+2\sqrt{2})$

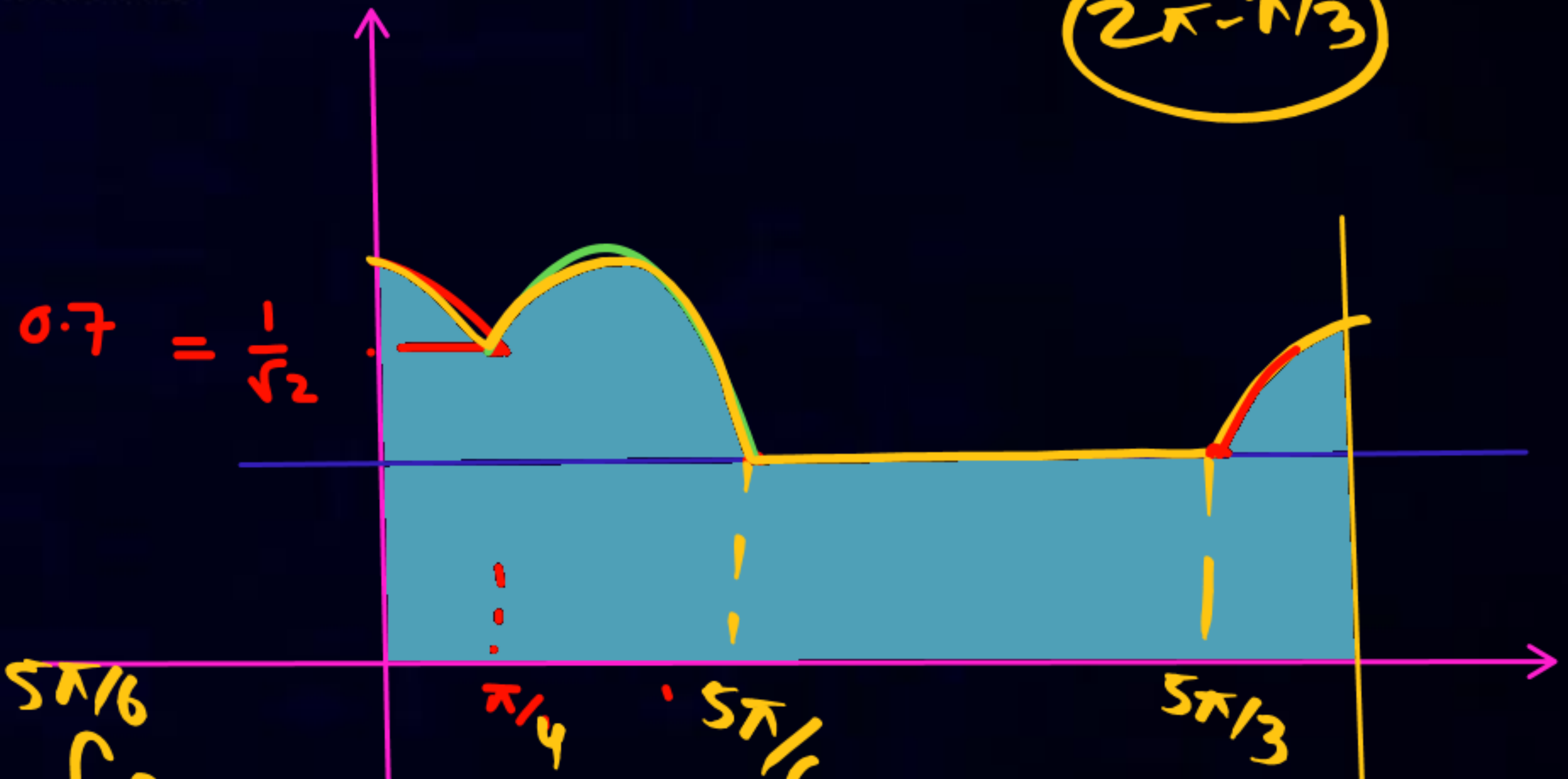
(D) $(1,-2,1+\sqrt{2})$

JEE MAIN 2024 LIVE PAPER DISCUSSION

If $f(x) = \max\left\{\sin x, \cos x, \frac{1}{2}\right\}$, then the area of the region bounded by the curves $y = f(x)$, x-axis, y-axis and $x = 2\pi$ is

$\sin x = \frac{1}{2}$

$2\pi - \pi/3$



(A) $\left(\frac{5\pi}{12} + 3\right)$ sq. units

(B) $\left(\frac{5\pi}{12} + \sqrt{2}\right)$ sq. units

(C) $\left(\frac{5\pi}{12} + \sqrt{3}\right)$ sq. units

(D) $\left(\frac{5\pi}{12} + \sqrt{2} + \sqrt{3}\right)$ sq. units

$\int_0^{\pi/4} \cos x \, dx + \int_{\pi/4}^{5\pi/6} \sin x \, dx + \frac{1}{2}\left[\frac{5\pi}{3} - \frac{5\pi}{6}\right] + \int_{5\pi/3}^{2\pi} \cos x \, dx$

Impt Points

Notes Revise

Paper discussion

Mock Paper

THANK YOU