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JEE (MAIN) 2025

MEMORY BASED QUESTIONS & TEXT SOLUTION

SHIFT-1

DATE & DAY: 03rd April 2025 & Thursday

PAPER-1

Duration: 3 Hrs.
Time: 09:00 – 12:00 IST

SUBJECT: MATHEMATICS

Selections in JEE (Advanced)/
IIT-JEE Since 2002

52395

Selections in JEE (Main)/
AIEEE Since 2009

257576

Selections in NEET (UG)/
AIPMT/ADMS Since 2012

22494

Admission Open for 2025-26

Target: JEE (Advanced) | JEE (Main) | NEET (UG) | PCCP (Class V to X)

100% Scholarship on the basis of Class 10th & 12th
& JEE (Main) 2025 %ile/ AIR

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PART : MATHEMATICS

1. $g(x)$ is a function such that $\int_0^x g(t) dt = x - \int_0^x t g(t) dt$ & $\frac{dy}{dx} - y \tan x = 2(x+1) g(x) \sec x$ such that

$y(0) = 0$ then $y\left(\frac{\pi}{3}\right) =$

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

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

(3) $\frac{4\pi}{3}$

(4) $\frac{5\pi}{3}$

Ans. (3)

Sol. $\int_0^x g(t) dt = x - \int_0^x t g(t) dt$

diff. w.r.t x both side

$g(x) = 1 - x g(x)$

$(1+x) g(x) = 1 \Rightarrow g(x) = \frac{1}{1+x}$

$\therefore \frac{dy}{dx} - y \tan x = 2 \sec x$

I.F. = $e^{\int \tan x dx} = e^{-\ln \sec x} = \cos x$

\therefore Solution is

$y \cos x = \int 2 \sec x \cos x dx + c$

$y \cos x = 2x + c$

$y(0) = 0 \therefore 0 = 0 + c \Rightarrow c = 0$

$\therefore y = 2x \sec x$

$\therefore y\left(\frac{\pi}{3}\right) = 2 \cdot \frac{\pi}{3} \cdot \sec \frac{\pi}{3} = \frac{4\pi}{3}$

2. Let A be 3×3 matrix such that $\det(A) = 5$ if $\det(2 \text{ adj}(3A, \text{adj}(2A))) = 2^\alpha \times 3^\beta \times 5^\gamma$ then $\alpha + \beta + \gamma$ is equal to

Ans. (27)

Sol. $\det(2 \text{ adj}(3A, \text{adj}(2A)))$

$= 2^3 |\text{adj}(3A, \text{adj}(2A))|$

$= 8 |3A, \text{adj}(2A)|^2$

$= 8 \times 3^6 |A, \text{adj}(2A)|^2$

$= 2^3 \times 3^6 |A|^2 |\text{adj}(2A)|^2$

$= 2^3 \times 3^6 \times 5^2 |2A|^4$

$= 2^3 \times 3^6 \times 5^2 \cdot 2^{12} |A|^4$

$= 2^{15} \times 3^6 \times 5^2 \times 5^4$

$= 2^{15} \times 3^6 \times 5^6$

$\alpha + \beta + \gamma = 27$

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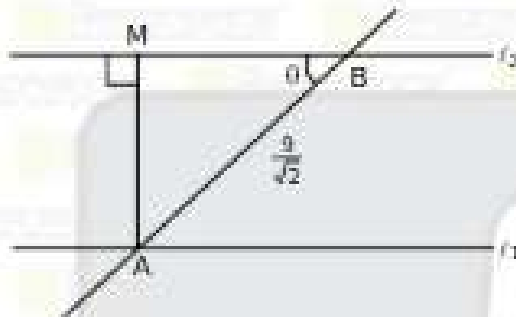
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3. A line with slope =1 cuts line $L_1 : 2x + y - 6 = 0$ at A & $L_2 : 4x + 2y - p = 0, p > 0$ at B such that $AB = \frac{9}{\sqrt{2}}$. A perpendicular AM from A drawn to line L_2 meets at M then $\frac{AM}{BM}$ is equal to

Ans. (3)

Sol.



$$\tan \theta = \frac{-2-1}{1-(-2)(1)} = \frac{3}{1}$$

$$\sin \theta = \frac{3}{\sqrt{10}}$$

$$AM = \frac{3}{\sqrt{10}} \times \frac{9}{\sqrt{2}} = \frac{27}{\sqrt{20}} = \frac{27}{2\sqrt{5}}$$

$$\text{dis. between } L_1 \text{ \& } L_2 \text{ } AM = \frac{\left| \frac{-p}{2} + 6 \right|}{\sqrt{5}}$$

$$6 - \frac{p}{2} = \pm \frac{27}{2}$$

$$6 + \frac{27}{2} = \frac{p}{2}$$

$$p = 39 \text{ as } p > 0$$

$$BM = \sqrt{\frac{81}{2} \left(\frac{27}{2\sqrt{5}} \right)^2}$$

$$= \sqrt{\frac{810 - 729}{20}} = \sqrt{\frac{81}{20}} = \frac{9}{2\sqrt{5}}$$

$$\text{Now } \frac{AM}{BM} = \frac{\frac{27}{2\sqrt{5}}}{\frac{9}{2\sqrt{5}}} = 3$$

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4. Let $f(x) = \int x^3 \sqrt{3-x^2} dx$ such that $5f(\sqrt{2}) = -4$ then $f(1) =$

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

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

(3) $-\frac{6\sqrt{2}}{5}$

(4) $\frac{6\sqrt{2}}{5}$

Ans. (3)

Sol. $f(x) = \int x^3 \sqrt{3-x^2} dx = \int x^2 \sqrt{3-x^2} x dx$

Let $3-x^2 = t \Rightarrow -2x dx = dt$

$$\therefore f(x) = \int (3-t)\sqrt{t} \left(-\frac{1}{2} dt\right) + c$$

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

$$= \frac{1}{2} \frac{t^{5/2}}{5/2} - \frac{3}{2} \frac{t^{3/2}}{3/2} + c$$

$$= \frac{t^{5/2}}{5} - t^{3/2} + c$$

$$= \frac{(3-x^2)^{5/2}}{5} - \frac{(3-x^2)^{3/2}}{1} + c$$

Put $x = \sqrt{2}$

$$\therefore f(\sqrt{2}) = -\frac{4}{5} = \frac{1}{5} - 1 + c$$

$$-\frac{4}{5} = -\frac{4}{5} + c \Rightarrow c = 0$$

$$\therefore f(x) = \frac{(3-x^2)^{5/2}}{5} - (3-x^2)^{3/2}$$

$$\therefore f(x) = \frac{2^{5/2}}{5} - 2^{3/2}$$

$$= \sqrt{2} \left(\frac{4}{5} - 2 \right)$$

$$= \sqrt{2} \left(-\frac{6}{5} \right) = -\frac{6\sqrt{2}}{5}$$

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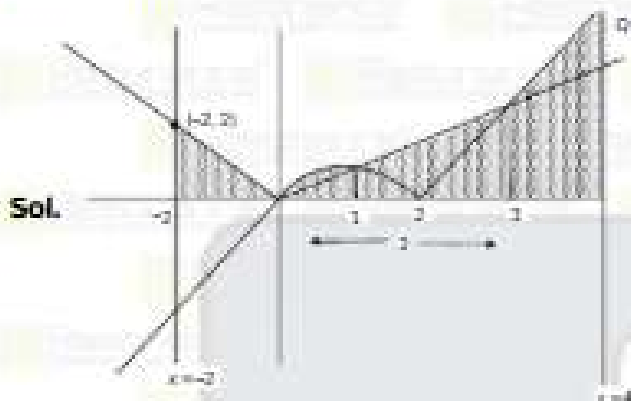
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5. Area between x-axis and curve $y = \max\{-|x|, x(x-2)\}$ from $x = -2$ to $x = 4$ is

Ans. (12)



$$\begin{aligned} \text{Required area} &= \frac{1}{2} \times 2 \times 2 + \int_0^2 (2x - x^2) dx \\ &\quad + \frac{1}{2} (2)(1-3) + \int_2^4 (x^2 - 2x) dx \\ &= 2 + \left(x^2 - \frac{x^3}{3} \right)_0^2 + 4 + \left(\frac{x^3}{3} - x^2 \right)_2^4 \\ &= 2 + \left(1 - \frac{1}{3} \right) + 4 + \left(\frac{64}{3} - 16 \right) - (9 - 9) \\ &= \frac{8}{3} + 4 + \frac{16}{3} = 12 \end{aligned}$$

6. Sum of all rational terms in expansion of $(2 + \sqrt{3})^8$

Ans. (18817)

Sol. $T_{r+1} = {}^8C_r \cdot 2^{8-r} \cdot 3^r$

for rational terms $r = 0, 2, 4, 6, 8$.

$$\begin{aligned} \text{sum} &= {}^8C_0 \cdot 2^8 \cdot 3^0 + {}^8C_2 \cdot 2^6 \cdot 3^2 + {}^8C_4 \cdot 2^4 \cdot 3^4 + {}^8C_6 \cdot 2^2 \cdot 3^6 + {}^8C_8 \cdot 2^0 \cdot 3^8 \\ &= 256 + 28 \times 64 \times 3 + 70 \times 16 \times 9 + 28 \times 4 \times 27 + 81 \\ &= 16 [16 + 336 + 360 + 189] + 81 \\ &= 16 \times 1171 + 81 \\ &= 18817 \end{aligned}$$

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7. $\sum_{r=1}^9 \frac{r+3}{2^r} {}^9C_r =$

(1) $\frac{3^{10}}{2^9} + 3$

(2) $\frac{3^{10}}{2^8} - 3$

(3) $\frac{3^{10}}{2^8} - 5$

(4) $\frac{3^{10}}{2^8} + 5$

Ans. (2)

Sol. $= \sum_{r=1}^9 \frac{r}{2^r} \frac{{}^9C_r}{r} + \sum_{r=1}^9 \frac{3}{2^r} \times {}^9C_r$

$= \frac{9}{2} \sum_{r=1}^9 {}^8C_{r-1} \frac{1}{2^{r-1}} + 3 \sum_{r=1}^9 \frac{{}^9C_r}{2^r}$

$= \frac{9}{2} \left(1 + \frac{1}{2}\right)^8 + 3 \left[\left(1 + \frac{1}{2}\right)^9 - 1\right]$

$= \frac{9}{2} \times \frac{3^8}{2^8} + 3 \times \frac{3^9}{2^9} - 3$

$= \frac{3^{10}}{2^8} + \frac{3^{10}}{2^9} - 3$

$= \frac{3^{10}}{2^8} - 3$

8. $y = \begin{vmatrix} \sin x & \cos x & \sin x + \cos x + 1 \\ 26 & 27 & 26 \\ 1 & 1 & 1 \end{vmatrix}$ then $\frac{d^2y}{dx^2} + y =$

(1) 0

(2) 1

(3) -1

(4) 2

Ans. (3)

Sol. $y = \begin{vmatrix} \sin x & \cos x & \sin x + \cos x + 1 \\ 26 & 27 & 26 \\ 1 & 1 & 1 \end{vmatrix}$

$= \sin x (27 - 26) - \cos x (26 - 26) + (\sin x + \cos x + 1) (26 - 27)$

$= \sin x - 0 - \sin x - \cos x - 1$

$y = -\cos x - 1$

$\therefore \frac{dy}{dx} = \sin x \quad \therefore \frac{d^2y}{dx^2} = \cos x$

$\therefore \frac{d^2y}{dx^2} = \cos x - \cos x - 1 = -1$ ans

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9. Let α, β are roots of $x^2 + \sqrt{3}x - 16 = 0$ & γ, δ are roots of $x^2 + 3x - 1 = 0$ and let $P_n = \alpha^n + \beta^n$ & $Q_n = \gamma^n + \delta^n$ the find value of $\frac{P_{25} + \sqrt{3}P_{24}}{2P_{23}} + \frac{Q_{24} - Q_{22}}{Q_{23}}$

Ans. (5)

Sol. α, β are roots of $x^2 + \sqrt{3}x - 16 = 0$

$$\therefore \alpha^n + \sqrt{3}\alpha^{n-1} - 16\alpha^{n-2} = 0$$

$$\beta^n + \sqrt{3}\beta^{n-1} - 16\beta^{n-2} = 0$$

$$P_n + \sqrt{3}P_{n-1} - 16P_{n-2} = 0$$

$$\therefore P_{25} + \sqrt{3}P_{24} - 16P_{23} = 0$$

$$\Rightarrow \frac{P_{25} + \sqrt{3}P_{24}}{2P_{23}} = 8$$

Similarly

$$Q_n + 3Q_{n-1} - Q_{n-2} = 0$$

$$\therefore Q_{24} + 3Q_{23} - Q_{22} = 0$$

$$\Rightarrow \frac{Q_{24} - Q_{22}}{Q_{23}} = -3$$

$$\therefore \frac{P_{25} + \sqrt{3}P_{24}}{2P_{23}} + \frac{Q_{24} - Q_{22}}{Q_{23}} = 8 - 3 = 5$$

10. The radius of smallest circle touches both parabolas externally $x^2 + 2 = y$ & $y^2 + 2 = x$

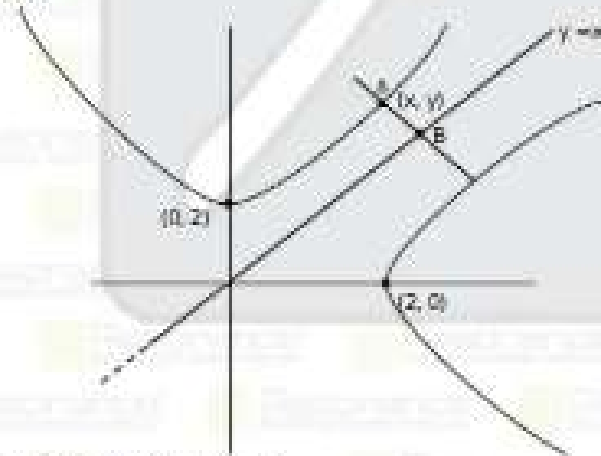
(1) $\frac{7}{4\sqrt{2}}$

(2) $\frac{7}{2\sqrt{2}}$

(3) $\frac{7}{3\sqrt{2}}$

(4) $\frac{7}{5\sqrt{2}}$

Ans. (1)



Sol.

$x^2 + 2 = y$ & $y^2 + 2 = x$
are inverse of each other

Let $A(x_1, y_1)$ lies on $x^2 + 2 = y$
then normal at A is

$$y - y_1 = -\frac{1}{2x_1}(x - x_1)$$

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$$\text{Slope of normal} = -\frac{1}{2x_1} = -1$$

$$x_1 = \frac{1}{2}$$

Put in $x^2 + 2 = y$

$$\frac{1}{4} + 2 = y$$

$$y = \frac{9}{4}$$

$$\text{radius } AB = \left| \frac{\frac{1}{2} - \frac{9}{4}}{\sqrt{2}} \right|$$

$$= \frac{7}{4\sqrt{2}}$$

11. Let positive numbers a_1, a_2, a_3, \dots are in G.P. such that $a_3 a_5 = 729$ & $a_2 + a_4 = \frac{111}{4}$, then $a_1 + a_2 + a_3 =$

(1) $\frac{41}{8}$

(2) $\frac{43}{8}$

(3) $\frac{45}{8}$

(4) $\frac{47}{8}$

Ans. (2)

Sol. Let a_1, a_2, a_3, \dots are in G.P.

$$a_3 a_5 = 729 \Rightarrow ar^2 \cdot ar^4 = 729$$

$$\Rightarrow a^2 r^6 = 729 \Rightarrow ar^3 = 27$$

$$\& a_2 + a_4 = \frac{111}{4} \Rightarrow ar + ar^3 = \frac{111}{4}$$

$$ar = \frac{111}{4} - 27 = \frac{111 - 108}{4} = \frac{3}{4}$$

$$\therefore \frac{ar^3}{ar} = 27 \times \frac{4}{3} = 9 \times 4$$

$$r^2 = 36 \quad \therefore r = 6 \quad \therefore a = \frac{3}{4} \times \frac{1}{6} = \frac{1}{8}$$

$$\therefore a = \frac{1}{8}, r = 6$$

$$\therefore a_1 + a_2 + a_3 = a + ar + ar^2 = a(1 + r + r^2)$$

$$= \frac{1}{8} (1 + 6 + 36) = \frac{43}{8}$$

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12. The sum of $1 + 3 + 11 + 25 + \dots$ upto 20 terms is

Ans. (7240)

Sol. $S = 1 + 3 + 11 + 25 + \dots$

$$t_n = an^2 + bn + c$$

$$t_1 = a + b + c = 1$$

$$t_2 = 4a + 2b + c = 3$$

$$t_3 = 9a + 3b + c = 11$$

$$\therefore 5a + b = 8$$

$$3a + b = 2$$

$$2a = 6$$

$$\therefore a = 3$$

$$\therefore b = -7, c = 5$$

$$\therefore t_n = 3n^2 - 7n + 5$$

$$\therefore S_n = \sum t_n = 3 \cdot \sum n^2 - 7 \sum n + \sum 5$$

$$S_n = 3 \cdot \frac{n(n+1)(2n+1)}{6} - 7 \cdot \frac{n(n+1)}{2} + 5n$$

$$\therefore S_{20} = 3 \cdot \frac{20 \cdot 21 \cdot 41}{6} - \frac{7}{2} \cdot 20 \cdot 21 + 100$$

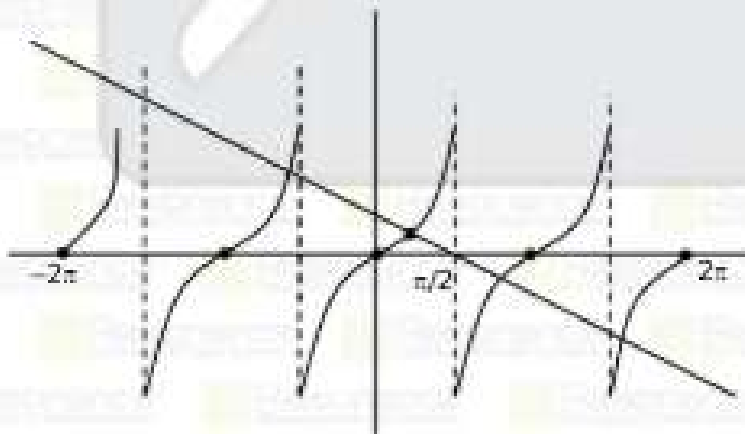
$$= 8610 - 1470 + 100$$

$$= 7240$$

13. Number of solutions of equation $2x + 3\tan x = \pi$, $\{x: x \neq (2n-1)\frac{\pi}{2}, x \in [-2\pi, 2\pi]\}$ is

Ans. (5)

Sol. $\tan x = \frac{\pi - 2x}{3}$



Total 5 solutions

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14. Domain of $f(x) = \cos^{-1}\left(\frac{3-2x}{5+4x}\right) + \sin^{-1}\left(\frac{4-3x}{2-x}\right)$ is $[a, b]$ then $a^2 + b^2$ is

- (1) $\frac{13}{2}$ (2) $\frac{13}{8}$ (3) $\frac{13}{4}$ (4) $\frac{11}{2}$

Ans. (3)

Sol. $\frac{3-2x}{5+4x} > 0$

$$x \in \left(-\frac{5}{4}, \frac{3}{2}\right) \quad (1)$$

$$\& \quad -1 \leq \frac{4-3x}{2-x} \leq 1$$

$$0 \leq \frac{2-x+4-3x}{2-x} \quad \& \quad \frac{4-3x-2+x}{2-x} \leq 0$$

$$0 \leq \frac{6-4x}{2-x} \quad \& \quad \frac{2-2x}{2-x} \leq 0$$

$$x \in \left(-\infty, \frac{3}{2}\right) \cup (2, \infty) \quad x \in [1, 2)$$

by (1) \cap (2) \cap (3)

$$\text{Domain } x \in \left[1, \frac{3}{2}\right)$$

$$\text{Now } a^2 + b^2 = 1 + \frac{9}{4} = \frac{13}{4}$$

15. A relation R is defined on Set $A = \{-3, -2, -1, 0, 1, 2, 3\}$; $R = \{(x, y) : 0 \leq x^2 + 2y \leq 4\}$. If $n(R) = m$ and minimum number of elements are added to R so that it becomes reflexive is n then $m + n$ is

Ans. (18)

Sol. for reflexive $x = y$

$$0 \leq x^2 + 2x \leq 4$$

$$x \in (-\infty, -2] \cup [0, \infty) \text{ and } x^2 + 2x - 4 \leq 0$$

$$x \in [-1 - \sqrt{5}, -1 + \sqrt{5}]$$

So R has $(-3, -3), (-2, -2), (0, 0), (1, 1)$

So 3 elements has to add for reflexive hence $n = 3$

also when $x = 0, y = 0, 1, 2 \rightarrow 3$ elements

when $x = \pm 1, y = 0, 1 \rightarrow 4$ elements

when $x = \pm 2, y = -2, -1, 0 \rightarrow 6$ elements

when $x = \pm 3, y = -3 \rightarrow 2$ elements

So total elements $m = 15$

So $m + n = 15 + 3 = 18$

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16. Let $f(x) = \begin{cases} (1+ax)^{\frac{1}{3}}, & x < 0 \\ b+1, & x = 0 \\ \frac{(x+4)^{\frac{1}{2}} - 2}{(x+c)^{\frac{1}{3}} - 2}, & x > 0 \end{cases}$ be a function. If $f(x)$ is continuity at $x = 0$ then $e^a \times bc =$

Ans. (48)

Sol. $f(x) = \begin{cases} (1+ax)^{\frac{1}{3}}, & x < 0 \\ b+1, & x = 0 \\ \frac{(x+4)^{\frac{1}{2}} - 2}{(x+c)^{\frac{1}{3}} - 2}, & x > 0 \end{cases}$

Hence $f(0) = b + 1$

RHL = $\lim_{x \rightarrow 0^+} \frac{(x+4)^{\frac{1}{2}} - 2}{(x+c)^{\frac{1}{3}} - 2}$ (for : form $c^{1/3} - 2 = 0, c = 8$)

$$= \lim_{x \rightarrow 0} \frac{2 \left(1 + \frac{x}{4}\right)^{\frac{1}{2}} - 2}{\left(1 + \frac{x}{8}\right)^{\frac{1}{3}} - 2}$$

$$= \lim_{x \rightarrow 0} \frac{1 + \frac{x}{8} - 1}{1 + \frac{x}{8} - 1} = \frac{\frac{1}{8}}{\frac{1}{8}} = 3$$

$$\therefore b + 1 = 3 \Rightarrow b = 2$$

LHL = $\lim_{x \rightarrow 0} (1+ax)^{\frac{1}{3}} = \lim_{x \rightarrow 0} e^{\frac{1+ax-1}{3}} = e^a = 3$

$\therefore e^a \cdot bc = 3 \cdot 2 \cdot 8 = 48$

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