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JEE (MAIN) 2025

MEMORY BASED QUESTIONS & TEXT SOLUTION

SHIFT-2

DATE & DAY: 02nd April 2025 & Wednesday

PAPER-1

Duration: 3 Hrs.

Time: 03:00 PM – 06:00 PM

SUBJECT: MATHEMATICS

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

52395

Selections in JEE (Main)/
AIEEE Since 2009

257576

Selections in NEET (UG)/
AI/PM/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
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PART : MATHEMATICS

1. The value of $\int_{-2}^2 \frac{9x^2}{1+5^x} dx$ is

(1) 12

(2) 24

(3) 30

(4) 15

Ans. (2)

Sol. $I = \int_{-2}^2 \frac{9x^2}{1+5^x} dx \dots\dots\dots (i)$

$$= \int_{-2}^2 \frac{9(0-x)^2}{1+5^{-x}} dx$$

$$= \int_{-2}^2 \frac{9x^2}{1+5^{-x}} dx$$

$$I = \int_{-2}^2 \frac{9x^2 5^x}{1+5^x} dx \dots\dots\dots (ii)$$

(i) + (ii)

$$2I = \int_{-2}^2 \frac{9x^2 (1+5^x)}{1+5^x} dx$$

$$2I = 2 \int_{-2}^2 9x^2 dx$$

$$I = \frac{9}{3} (8) = 24$$

$$I = 24$$

2. The eccentricity of ellipse in which length of minor axis is equal to one fourth of the distance between foci, is

(1) $\frac{4}{\sqrt{17}}$

(2) $\frac{2}{\sqrt{17}}$

(3) $\frac{7}{\sqrt{17}}$

(4) $\frac{8}{\sqrt{17}}$

Ans. (1)

Sol. $2b = \frac{1}{4} \times 2ae$ & $b^2 = a^2 (1 - e^2)$

$$\Rightarrow 4b = ae$$

$$\Rightarrow 16b^2 = a^2 e^2$$

$$\Rightarrow 16a^2 (1 - e^2) = a^2 e^2$$

$$\Rightarrow 16 = 17e^2$$

$$\Rightarrow e = \frac{4}{\sqrt{17}}$$

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3. Total number of terms in an A.P. are even, sum of odd terms is 24 and sum of even terms is 30. Last term exceeds the first terms by $\frac{21}{2}$. Then total number of terms is _____.

Ans. (8)

Sol. Let $2n$ be number of terms

$$T_1 + T_3 + \dots + T_{2n-1} = 24 \quad \dots(1)$$

$$T_2 + T_4 + \dots + T_{2n} = 30 \quad \dots(2)$$

$$(2) - (1) \Rightarrow nd = 6$$

$$\& \quad T_{2n} - T_1 = \frac{21}{2}$$

$$\Rightarrow T_1 + (2n - 1)d - T_1 = \frac{21}{2}$$

$$\Rightarrow 2nd - d = \frac{21}{2} \Rightarrow 12 - d = \frac{21}{2}$$

$$\Rightarrow d = 12 - \frac{21}{2} = \frac{3}{2}$$

$$nd = 6 \Rightarrow n \times \frac{3}{2} = 6 \Rightarrow n = 4$$

4. If the domain of the function

$$f(x) = \frac{1}{\sqrt{3x+10-x^2}} + \frac{1}{\sqrt{x+|x|}} \text{ is } (a, b) \text{ then } (1+a)^2 + b^2 \text{ is equal to } \underline{\hspace{2cm}}.$$

Ans. (26)

$$\text{Sol. } 3x + 10 - x^2 > 0 \quad \& \quad x + |x| > 0$$

$$\Rightarrow x^2 - 3x - 10 < 0$$

$$\& \quad \begin{array}{c} \swarrow \quad \searrow \\ x > 0 \quad \text{or} \quad x < 0 \end{array}$$

$$\Rightarrow (x - 5)(x + 2) < 0$$

$$\Rightarrow 2x > 0$$

$$\Rightarrow x - x > 0$$

$$\Rightarrow -2 < x < 5$$

$$\Rightarrow x > 0$$

$$\Rightarrow 0 > 0, x = \phi$$

$$\text{So } x \in (0, 5)$$

$$\Rightarrow a = 0, b = 5$$

$$\Rightarrow (1+a)^2 + b^2 = 1 + 25 = 26$$

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5. If $\frac{dy}{dx} + 2y \sec^2 x = 2 \sec^2 x + 3 \tan x \sec^2 x$ and $f(0) = \frac{5}{4}$. Then the value of $12 \left(y\left(\frac{\pi}{4}\right) - \frac{1}{e^2} \right)$ is equal to ____.

Ans. (21)

Sol. $\frac{dy}{dx} + py = Q \Rightarrow y.e^{\int P dx} = \int Q.e^{\int P dx} dx$

$$y.e^{2 \tan x} = \int (2 \sec^2 x + 3 \tan x \sec^2 x).e^{2 \tan x} dx$$

$$y.e^{2 \tan x} = \int (2 + 3 \tan x).e^{2 \tan x} \sec^2 x dx$$

$$= \int \left(2 + 3 \cdot \frac{t}{2} \right).e^t \cdot \frac{dt}{2}$$

$$2 \tan x = t$$

$$2 \sec^2 x dx = dt$$

$$= \frac{1}{4} \int (4 + 3t).e^t dt$$

$$= \frac{1}{4} \left\{ (4 + 3t).e^t - \int 3.e^t dt \right\}$$

$$= \frac{1}{4} (4 + 3t).e^t - \frac{3}{4} e^t$$

$$= \frac{1}{4} (4 + 6 \tan x).e^{2 \tan x} - \frac{3}{4} e^{2 \tan x}$$

$$= \frac{1}{4} (4 + 6 \tan x - 3).e^{2 \tan x} + C$$

$$\Rightarrow y.e^{2 \tan x} = \frac{(1 + 6 \tan x).e^{2 \tan x}}{4} + C$$

$$\frac{5}{4} - \frac{1}{4} + C \Rightarrow C = 1$$

$$\text{So } y\left(\frac{\pi}{4}\right).e^2 = \frac{7}{4}.e^2 + 1$$

$$y\left(\frac{\pi}{4}\right) = \frac{7}{4} + \frac{1}{e^2}$$

$$12 \left(y\left(\frac{\pi}{4}\right) - \frac{1}{e^2} \right) = 21$$

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6. Let $10 \int_1^x f(t) dt = 5xf(x) + x^5 + 9$, where $x \geq 1$ & $f(x) \geq 2$, then value of $f(3)$ is equal to

- (1) 32 (2) -32 (3) 64 (4) -64

Ans. (2)

Sol. $10f(x) = 5f(x) + 5x f'(x) + 5x^4$

$$f(x) = x f'(x) + x^4$$

$$f(x) - \frac{1}{x} f(x) = -x^3$$

$$\text{I.F. } e^{-\int \frac{1}{x} dx} = e^{-\ln x} = \frac{1}{x}$$

Sol. $y \cdot \frac{1}{x} = -\int \frac{1}{x} \cdot x^3 dx + C$

$$\frac{y}{x} = -\frac{x^3}{3} + C$$

$$f(1) = (-2) \quad -\frac{2}{1} = -\frac{1}{3} + C \quad C = -\frac{5}{3}$$

$$f(x) = y = -\frac{x^4}{3} - \frac{5}{3}x$$

$$f(3) = -3^3 - 5$$

$$f(3) = -27 - 5 = -32$$

7. There are '3' bags with following balls.

	Red	Blue	Green
Bag - I	4	3	3
Bag - II	2	3	5
Bag - III	6	2	2

Given that $P(I/R) = p$ and $P(III/G) = q$

Then $\frac{1}{p} + \frac{1}{q}$ is _____.

- (1) 8 (2) 6 (3) 4 (4) 10

Ans. (1)

Sol. $P(I/R) = \frac{\frac{1}{3} \times \frac{4}{10}}{\frac{1}{3} \times \frac{4}{10} + \frac{1}{3} \times \frac{2}{10} + \frac{1}{3} \times \frac{6}{10}} = \frac{4}{12} = \frac{1}{3} = p$

$$P(III/G) = \frac{\frac{1}{3} \times \frac{2}{10}}{\frac{1}{3} \times \frac{3}{10} + \frac{1}{3} \times \frac{5}{10} + \frac{1}{3} \times \frac{2}{10}} = \frac{2}{10}$$

$$= \frac{1}{5} = q$$

So, $\frac{1}{p} + \frac{1}{q} = 3 + 5 = 8$

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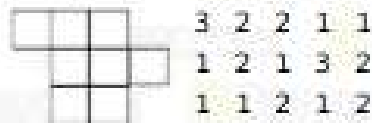
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8. The number of ways to arrange the letters A, B, C, D, E in given figure if every row has atleast one letter is -



3 2 2 1 1
1 2 1 3 2
1 1 2 1 2

Ans. (5760)

Sol. R_1 R_2 R_3

3 1 1

2 2 1

2 1 2

1 3 1

1 2 2

$$({}^3C_3 \times {}^1C_1 \times {}^1C_1 + {}^3C_2 \times {}^2C_2 + {}^3C_2 \times {}^1C_1 + {}^3C_1 \times {}^2C_2 + {}^3C_1 \times {}^1C_3 + {}^3C_1 \times {}^2C_1 + {}^3C_1 \times {}^1C_2 + {}^3C_1 \times {}^1C_1) 5!$$

$$(6 + 18 + 9 + 6 + 9) 5!$$

$$= 48 \times 120$$

$$= 5760 \text{ Ans.}$$

9. If mean and variance of eight observations a,b,8,12,10,6,4,15 is 9 and 9.25 respectively. Then a + b + ab is equal to

(1) 76

(2) 83

(3) 79

(4) 93

Ans. (4)

Sol. $\bar{x} = \frac{a+b+55}{8} = 9 \Rightarrow a+b = 72 - 55$

$$a + b = 17 \dots\dots\dots(i)$$

$$\sigma^2 = \frac{\sum x_i^2}{8} - \bar{x}^2 = \frac{a^2 + b^2 + 64 + 144 + 100 + 36 + 16 + 225}{8} - 9^2$$

$$\Rightarrow \frac{a^2 + b^2 + 585}{8} = 81 - 9.25$$

$$a^2 + b^2 - 63 = 74 \Rightarrow a^2 + b^2 = 137 \dots\dots\dots(ii)$$

$$(a+b)^2 = 289 \Rightarrow 137 + 2ab = 289$$

$$\Rightarrow 2ab = 152$$

$$\Rightarrow ab = 76$$

$$\text{So, } a + b + ab = 17 + 76 = 93$$

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10. The value of $4 \int_0^1 \frac{1}{\sqrt{1+x^2} + \sqrt{3+x^2}} dx - 3\ln\sqrt{3}$ is

(1) $2 + \sqrt{2} - \ln(1 + \sqrt{2})$

(2) $2 - \sqrt{2} - \ln(1 + \sqrt{2})$

(3) $2 - \sqrt{2} + \ln(1 + \sqrt{2})$

(4) $2 + \sqrt{2} + \ln(1 + \sqrt{2})$

Ans. (2)

Sol. Let $A = 4 \int_0^1 \frac{(\sqrt{3+x^2} - \sqrt{1+x^2})}{2} dx$

$$A = 2 \int_0^1 (\sqrt{3+x^2} - \sqrt{1+x^2}) dx$$

$$A = 2 \left[\frac{1}{2} x \sqrt{3+x^2} + \frac{3}{2} \ln(x + \sqrt{3+x^2}) - \frac{1}{2} x \sqrt{1+x^2} - \frac{1}{2} \ln(x + \sqrt{1+x^2}) \right]_0^1$$

$$A = 2 + 3 \ln(3) - \sqrt{2} - \ln(1 + \sqrt{2}) - [3\ln\sqrt{3}]$$

$$A = 2 - \sqrt{2} - \ln(1 + \sqrt{2}) + 3\ln\sqrt{3}$$

$$\begin{aligned} A - 3\ln\sqrt{3} &= 2 - \sqrt{2} - \ln(1 + \sqrt{2}) + 3\ln\sqrt{3} - 3\ln\sqrt{3} \\ &= 2 - \sqrt{2} - \ln(1 + \sqrt{2}) \end{aligned}$$

11. If $\lim_{x \rightarrow 0} \frac{\cos(2x) - a \cos(4x) + b}{x^4}$ exists then the value of $(a + b)$ is.

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

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

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

(4) -1

Ans. (3)

Sol. Let $L = \lim_{x \rightarrow 0} \frac{\cos 2x - a \cos 4x + b}{x^4}$

$$= \lim_{x \rightarrow 0} \frac{\left(1 - \frac{(2x)^2}{2!} + \frac{(2x)^4}{4!} - \dots\right) - a \left(1 - \frac{(4x)^2}{2!} + \frac{(4x)^4}{4!} - \dots\right) + b}{x^4}$$

$$= \lim_{x \rightarrow 0} \frac{(1 - a + b) + x^2(-2 + 8a) + x^4\left(\frac{2}{3} - \frac{32a}{3}\right) + \dots}{x^4}$$

For L to exist

$$1 - a + b = 0 \quad \text{and} \quad -2 + 8a = 0$$

$$a - b = 1 \quad \text{and} \quad a = \frac{1}{4}$$

$$b = a - 1 = \frac{1}{4} - 1 = -\frac{3}{4}$$

$$a + b = \frac{1}{4} - \frac{3}{4} = -\frac{1}{2}$$

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12. Let $\sum_{r=0}^{10} \left(\frac{10^{r-1}-1}{10^r} \right)^{11} C_{r+1} = \frac{n^{11} - (11)^{11}}{10^{10}}$, the value of n is.

Ans. (20)

$$\begin{aligned} \text{Sol. } 10 \sum_{r=0}^{10} {}^{11}C_{r+1} &= 10 \sum_{r=0}^{10} {}^{11}C_{r+1} \left(\frac{1}{10} \right)^{r+2} \\ &= 10 \left[2^{11} - 1 \right] - 10 \left[\left(1 + \frac{1}{10} \right)^{11} - {}^{11}C_0 \left(\frac{1}{10} \right)^0 \right] \\ &= 10 \left[2^{11} - 1 - \left(\frac{11}{10} \right)^{11} + 1 \right] \\ &= \frac{20^{11} - 11^{11}}{10^{10}} \end{aligned}$$

So $n = 20$ Ans.

13. Consider the series $\frac{4(1)}{1+4(1)^2} + \frac{4(2)}{1+4(2)^2} + \frac{4(3)}{1+4(3)^2} + \dots$. Find the sum of its first 10 times.

(1) $\frac{220}{221}$

(2) $\frac{221}{220}$

(3) 1

(4) $\frac{219}{220}$

Ans. (1)

$$\begin{aligned} \text{Sol. } \therefore T_n &= \frac{4n}{1+4n^2} = \frac{4n}{(2n^2+1)-4n^2} \\ &= \frac{4n}{(2n^2+1+2n)-(2n^2+1-2n)} \\ &= \frac{1}{(2n^2-2n+1)} - \frac{1}{(2n^2+2n+1)} \\ \therefore \sum_{n=1}^{10} T_n &= \left(\frac{1}{5} - \frac{1}{5} \right) + \left(\frac{1}{5} - \frac{1}{5} \right) \\ &= \frac{1}{13} - \frac{1}{25} \\ &= \frac{1}{181} - \frac{1}{221} \\ \therefore \sum_{n=1}^{10} T_n &= 1 - \frac{1}{221} = \frac{220}{221} \end{aligned}$$

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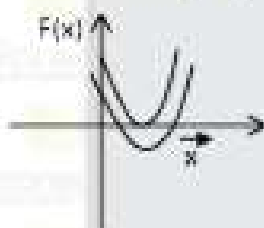
14. If the roots of the equation $(1-a)x^2 + 2(a-3)x + 9 = 0$ are positive, then $a \in (-\infty, \lambda] \cup [\mu, \delta)$. The value of $\lambda^2 + \mu^2 + \delta^2$ is

Ans. (10)

Sol. $(1-a)x^2 + 2(a-3)x + 9 = 0$

$$x^2 + \frac{2(a-3)}{(1-a)}x + \frac{9}{1-a} = 0$$

$$\text{Let } f(x) = x^2 + \frac{2(a-3)}{(1-a)}x + \frac{9}{1-a}$$



For roots to be positive

$$(i) f(0) > 0$$

$$(ii) \Delta \geq 0$$

$$(iii) -\frac{b}{2a} > 0$$

$$(i) f(0) > 0 \Rightarrow \frac{9}{1-a} > 0 \Rightarrow a < 1$$

$$(ii) \Delta \geq 0 \Rightarrow \frac{4(a-3)^2}{(1-a)^2} - 4 \times 1 \times \frac{9}{(1-a)} \geq 0$$

$$4(a-3)^2 - 36(1-a) \geq 0; a < 1$$

$$(a-3)^2 - 9(1-a) \geq 0$$

$$a^2 - 6a + 9 - 9 + 9a \geq 0$$

$$a^2 + 3a \geq 0$$

$$a(a+3) \geq 0$$



$$(iii) -\frac{b}{2a} > 0 \Rightarrow -\frac{2\left(\frac{a-3}{1-a}\right)}{2} > 0 \Rightarrow \frac{a-3}{a-1} > 0$$



$$\therefore (i) \cap (ii) \cap (iii)$$

$$\Rightarrow a \in (-\infty, -3] \cup [0, 1)$$

$$\therefore \lambda = -3, \mu = 0 \text{ and } \delta = 1$$

$$\therefore \lambda^2 + \mu^2 + \delta^2 = 9 + 0 + 1 = 10$$

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15. 'A' be a matrix such that $A^2(A - I) - 4(A - I) = 0$. If $A^3 = \lambda A^2 + \mu A + \delta I$, then find the value of $(\lambda + \mu + \delta)$

Ans. (1)

Sol. $\because A^2(A - I) - 4(A - I) = 0$
 $A^3 - A^2 - 4A + 4I = 0$
 $A^3 = A^2 + 4A - 4I$
 $\Rightarrow A^4 = A^3 + 4A^2 - 4A$
 $= (A^2 + 4A - 4I) + 4A^2 - 4A$
 $A^4 = 5A^2 - 4I$
 $\Rightarrow A^5 = 5A^3 - 4A$
 $= 5(A^2 + 4A - 4I) - 4A$
 $A^5 = 5A^2 + 16A - 20I$
 $\Rightarrow \lambda = 5; \mu = 16; \delta = -20$
 $\therefore \lambda + \mu + \delta = 1$

16. Consider a triangle ABC, where A (4, -2), B(1, 1) and C(9, 3) a parallelogram ADEF is drawn such that D lies on AB, E lies on BC and F lies on AC. The maximum area of parallelogram is

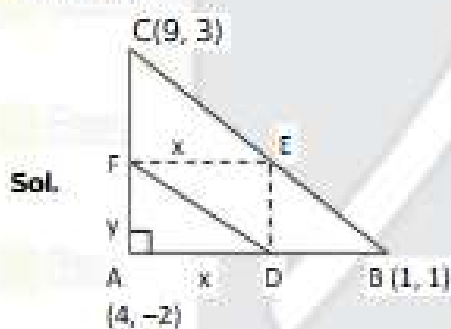
(1) $\frac{7}{2}$

(2) $\frac{15}{2}$

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

(4) $\frac{17}{2}$

Ans. (2)



$\because AB = \sqrt{9+9} = 3\sqrt{2} = c$ $BC = \sqrt{64+4} = 2\sqrt{17} = a$ $CA = \sqrt{25+25} = 5\sqrt{2} = b$
 $\because a^2 = b^2 + c^2$
 $\Rightarrow \Delta ABC$ is right angled
 $\because$ area of || gram $= xy$ (i)
 $\because \frac{x}{c} = \frac{b-y}{b} \Rightarrow x = \frac{c}{b} (b-y)$
 $\therefore A = xy = \frac{c}{b} y (b-y)$
 $\therefore A = xy = \frac{c}{b} (by - y^2)$
 $\therefore A$ maximum will be at $y = \frac{b}{2}$
 $\therefore A \text{ maximum} = \frac{bc}{4} = \frac{15 \times 2}{4} = 7.5$

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