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# JEE (MAIN) 2024

**MEMORY BASED QUESTIONS & SOLUTIONS**

**SHIFT-1**

**DATE & DAY:** 29<sup>th</sup> January 2024 & Monday

**PAPER-1**

**Duration:** 3 Hrs.  
**Time:** 09:00 - 12:00 IST

**SUBJECT: MATHEMATICS**

**ADMISSIONS OPEN FOR CLASS 12+**

ACADEMIC SESSION 2024-25



**TARGET: JEE (ADV.) 2024**

For Class XII Passed Student

**VISHESH COURSE**

MODE: OFFLINE/ONLINE



CLASS STARTS  
**08<sup>TH</sup> APRIL, 2024**



**TARGET: JEE (MAIN) 2024**

For Class XII Passed Student

**ABHYAAS COURSE**

MODE: OFFLINE/ONLINE



CLASS STARTS  
**08<sup>TH</sup> APRIL, 2024**

**SCHOLARSHIP ON THE BASIS OF JEE (MAIN) 2024 %ILE/AIR**

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## PART : MATHEMATICS

1. What is probability of getting '2' in even number of throws of a die is ?

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

Ans. (2)

Sol. Let P is probability of getting 2 in single through then  $P = \frac{1}{6}$ .

Hence probability of getting 2 in even trial =  $\overline{P}P + \overline{P}P\overline{P}P + \overline{P}P\overline{P}P\overline{P}P + \dots \infty$

$$= \frac{\overline{P}P}{1 - \overline{P}\overline{P}} = \frac{\frac{5}{6} \times \frac{1}{6}}{1 - \frac{5}{6} \times \frac{5}{6}} = \frac{5}{11}$$

2. A G.P. of 64 terms is such that  $S_n$  (total) = 7( $S_n$ )<sub>odd terms</sub> then common ratio of G.P is

- (1) 2 (2) 6 (3) 10 (4) 14

Ans. (2)

Sol.  $a + ar + ar^2 + \dots + 64 \text{ terms} = 7(a + ar^2 + ar^4 + \dots + 32 \text{ terms})$

$$\frac{a(r^{64} - 1)}{r - 1} = 7 \left( \frac{a(r^2)^{32} - 1}{r^2 - 1} \right)$$

$$1 = \frac{7}{r + 1}$$

$$r + 1 = 7$$

$$r = 6$$

3. Value of  $\lim_{x \rightarrow \frac{\pi}{2}} \int_{x^3}^{\left(\frac{\pi}{2}\right)^3} \frac{\cos(t^{1/3})}{(x - \pi/2)^2} dt$  is

- (1)  $3\left(\frac{\pi}{3}\right)^3$  (2)  $\frac{3}{2}\left(\frac{\pi}{2}\right)^2$  (3)  $\left(\frac{\pi}{2}\right)^3$  (4)  $\left(\frac{\pi}{2}\right)^2$

Ans. (2)

Sol. Apply L-H rule

$$\lim_{x \rightarrow \pi/2} \frac{\cos(\pi/2) \times 0 - \cos(x)(3x^2)}{2(x - \pi/2)(1)} \quad (\text{by Leibnitz theorem})$$

$$\lim_{x \rightarrow \pi/2} \frac{-\sin(\pi/2 - x)}{-(\pi/2 - x)} \cdot \frac{3}{2} x^2 = \frac{3}{2} \left( \frac{\pi}{2} \right)^2$$

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4. If all word by using letters of word "GTWENTY" are arranged as in dictionary, then rank of the word "GTWENTY" is

(1) 552 (2) 553 (3) 554 (4) 551

Ans. (2)

Sol. Alphabetical order of letters of the word is

E, G, N, T, T, W, Y

For rank of word

G T W E N T Y

$$\frac{1}{2} \left| \frac{6}{2} \right| + \frac{2}{2} \left| \frac{5}{2} \right| + 3 \left| \frac{4}{2} + 0 \right| + 3 \left| \frac{3}{2} + 0 \right| + 2 \left| \frac{2}{2} + 0 \right| + 1 \left| \frac{1}{2} + 0 \right| + 0 + 1$$

$$= 360 + 120 + 72 + 1 = 553$$

5. If  $\frac{{}^{11}C_1}{2} + \frac{{}^{11}C_2}{3} + \dots + \frac{{}^{11}C_9}{10} = \frac{n}{m}$ , then value of  $n+m-8$  is

(1) 2033 (2) 2034 (3) 2032 (4) 2034

Ans. (1)

Sol.  $\frac{{}^{11}C_1}{2} + \frac{{}^{11}C_2}{3} + \frac{{}^{11}C_3}{4} + \dots + \frac{{}^{11}C_9}{10} = \sum_{r=1}^9 \frac{1}{(r+1)} {}^{11}C_r$

$$= \frac{1}{12} \sum_{r=1}^9 \frac{12}{r+1} {}^{11}C_r$$

$$= \frac{1}{12} \sum_{r=1}^9 {}^{12}C_{r+1}$$

$$= \frac{1}{12} ({}^{12}C_2 + {}^{12}C_3 + \dots + {}^{12}C_{10})$$

$$= \frac{1}{12} (2^{12} - {}^{12}C_0 - {}^{12}C_1 - {}^{12}C_{11} - {}^{12}C_{12})$$

$$= \frac{1}{12} (2^{12} - 2 - 24)$$

$$= \frac{1}{12} (2^{12} - 26)$$

$$= \frac{1}{6} (2048 - 13) = \frac{2035}{6}$$

$$n = 2035, m = 6$$

$$\text{Hence } n + m - 8 = 2035 + 6 - 8 = 2033$$

6. In an A.P  $a_6 = 2$  then common difference for which  $a_1, a_3, a_6$  is least is

(1)  $\frac{16}{15}$  (2)  $\frac{8}{15}$  (3)  $\frac{15}{8}$  (4)  $\frac{15}{16}$

Ans. (2)

Sol.  $a_6 = a + 5d = 2 \Rightarrow a = 2 - 5d$

$$P = a_1 a_3 a_6$$

$$= a(a + 2d)^2$$

$$= (2 - 5d)(2 - 3d)^2$$

$$P = 2(4 - 16d + 15d^2)$$

$$\frac{dP}{dd} = 2(-16 + 30d)$$

$$\text{So at } d = \frac{16}{30} = \frac{8}{15}, P \text{ will be least}$$

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7.  $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \alpha & \beta \\ 0 & \beta & \alpha \end{bmatrix}$  and  $|2A|^3 = 2^{21}$  then, find  $\alpha$  ( $\alpha, \beta \in \mathbb{I}^+$ )

- (1) 3 (2) 4 (3) 5 (4) 6

Ans. (3)

Sol.

$$\alpha^2 - \beta^2 = |A|$$

$$\text{And } |2A|^3 = 2^{21}$$

$$\text{Now } (2^3|A|)^3 = 2^{21}$$

$$|A| = 2^4$$

$$\alpha^2 - \beta^2 = 16$$

$$(\alpha - \beta)(\alpha + \beta) = 16$$

$$\text{Case: I } \alpha + \beta = 8$$

$$\alpha - \beta = 2 \rightarrow \alpha = 5, \beta = 3$$

8. If  $4\cos\theta + 5\sin\theta = 1$  and  $\alpha$  satisfy equation and  $\alpha \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$  then, value of  $\tan \alpha$  is

- (1)  $\frac{\sqrt{10}+10}{12}$  (2)  $\frac{\sqrt{10}-10}{12}$  (3)  $\frac{10-\sqrt{10}}{12}$  (4)  $\frac{\sqrt{10}+10}{6}$

Ans. (2)

Sol.

$$4\cos\theta + 5\sin\theta = 1$$

$$4\left(\frac{1-\tan^2(\theta/2)}{1+\tan^2(\theta/2)}\right) + 5\left(\frac{2\tan(\theta/2)}{1+\tan^2(\theta/2)}\right) = 1$$

$$\Rightarrow 5\tan^2(\theta/2) - 10\tan(\theta/2) - 3 = 0$$

$$\Rightarrow \tan(\theta/2) = \frac{10 \pm \sqrt{100 - 4(5)(-3)}}{2 \times 5} = \frac{10 \pm \sqrt{160}}{10} = \frac{5 \pm \sqrt{40}}{5}$$

$$\therefore \alpha \in (-\pi/2, \pi/2)$$

$$\frac{\alpha}{2} \in (-\pi/4, \pi/4)$$

$$\tan(\alpha/2) \in (-1, 1) \text{ Hence } \tan(\alpha/2) = \frac{5 - \sqrt{40}}{5}$$

$$\tan \alpha = \frac{2\tan(\alpha/2)}{1 - \tan^2(\alpha/2)} = \frac{2\left(\frac{5 - \sqrt{40}}{5}\right)}{1 - \left(\frac{5 - \sqrt{40}}{5}\right)^2} = \frac{2\left(\frac{5 - \sqrt{40}}{5}\right)}{1 - \left(1 + \frac{40}{25} - \frac{2\sqrt{40}}{5}\right)}$$

$$= \frac{2\left(\frac{5 - \sqrt{40}}{5}\right)}{\frac{2\sqrt{40} - 8}{5}} = \frac{5 - \sqrt{40}}{\sqrt{40} - 4} \times \frac{\sqrt{40} + 4}{\sqrt{40} + 4}$$

$$= \frac{5\sqrt{40} + 20 - 40 - 4\sqrt{40}}{24}$$

$$= \frac{\sqrt{40} - 20}{24} = \frac{\sqrt{10} - 10}{12}$$

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9. 
$$f(x) = \begin{cases} 2+2x & -3 \leq x \leq 0 \\ 1-\frac{x}{2} & 0 < x \leq 1 \end{cases}$$

$$g(x) = \begin{cases} -x & -1 \leq x < 0 \\ x & 0 \leq x \leq 1 \end{cases}$$

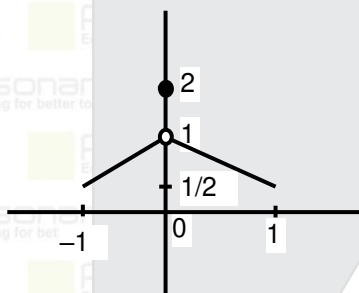
Range of  $\text{fog}(x)$  is

(1)  $\left[\frac{1}{2}, 4\right]$  (2)  $\left(-\infty, \frac{1}{2}\right) \cup [1, 2)$  (3)  $\left[\frac{1}{2}, 1\right) \cup \{2\}$  (4)  $\left[\frac{1}{2}, 1\right) \cup [4, \infty]$

Ans. (3)

Sol. 
$$f(g(x)) = \begin{cases} 2+2g(x) & -3 \leq g(x) \leq 0 \\ 1-\frac{g(x)}{2} & 0 < g(x) \leq 1 \end{cases}$$

$$= \begin{cases} 2-2x & -3 \leq -x \leq 0 \text{ and } -1 \leq x < 0 \\ 1+\frac{x}{2} & 0 < -x \leq 1 \text{ and } -1 \leq x < 0 \\ 2+2x & -3 \leq x \leq 0 \text{ and } 0 \leq x \leq 1 \\ 1-\frac{x}{2} & 0 < x \leq 1 \text{ and } 0 \leq x \leq 1 \end{cases} = \begin{cases} 1+\frac{x}{2} & -1 \leq x < 0 \\ 2+2x & x = 0 \\ 1-\frac{x}{2} & 0 < x \leq 1 \end{cases}$$



So range of

$\text{fog}(x)$  is  $\left[\frac{1}{2}, 1\right) \cup \{2\}$

10. If  $AA^T = I$ , where  $A^T$  is transpose of matrix  $A$  then,  $\frac{1}{2}A[(A+A^T)^2 + (A-A^T)^2] = ?$

(1)  $A^2$  (2)  $A^3 + I$  (3)  $A^2 + I$  (4)  $A^3 + A^T$

Ans. (4)

Sol. 
$$\frac{1}{2}A[2A^2 + 2(A^T)^2]$$
  

$$= A^3 + A(A^T)^2$$
  

$$= A^3 + A^T$$

11. A relation  $R$  is defined on  $I \times I$  such that  $(a, b)R(c, d)$  if and only if  $ad - bc$  is divisible by 5, then relation  $R$  is a

- (1) Reflexive and symmetric relation both  
 (2) symmetric and transitive relation both  
 (3) Transitive and reflexive relation both  
 (4) Equivalence relation

Ans. (1)

Sol.  $\forall (a, b) \in I \times I$   
 $ab - ba = 0$ , which is divisible by 5 always  
 $\Rightarrow (a, b)R(a, b)$   
 So  $R$  is a reflexive relation

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If  $(a, b) R (c, d) \Rightarrow ad - bc$  is divisible by 5

$\Rightarrow cb - da$  is divisible by 5

$\Rightarrow (c, d) R (a, b)$

So,  $R$  is a symmetric relation.

If  $(a, b) R (c, d)$  and  $(c, d) R (e, f) \Rightarrow ad - bc = 5\lambda$  and  $cf - de = 5\mu$

$\Rightarrow af - be$  need not be multiple of 5  $\Rightarrow (a, b) \not R (e, f)$

Let  $(a, b) = (6, 1), (c, d) = (0, 0), (e, f) = (1, 7)$

$ad - bc = 0$  and  $cf - de = 0$

but  $af - be = 42 - 1 = 41$  is not multiple of 5

so  $R$  is not a transitive relation

12.  $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \left( \frac{x^2 \cos x}{1 + \pi^x} + \frac{\sin^2 x + 1}{e^{\sin^{2025} x} + 1} \right) dx$

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

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

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

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

Ans. (3)

Sol. By even odd property

$$\int_0^{\frac{\pi}{2}} (x^2 \cos x + \sin^2 x + 1) dx$$

$$\int_0^{\frac{\pi}{2}} \left( x^2 \cos x + \frac{3}{2} - \frac{\cos 2x}{2} \right) dx$$

$$\left( x^2 \sin x - \int 2x \sin x dx + \frac{3x}{2} - \frac{\sin 2x}{4} \right) \Big|_0^{\frac{\pi}{2}}$$

$$= \left[ x^2 \sin x - \left[ 2x(-\cos x) - \int 2(-\cos x) dx \right] + \frac{3x}{2} - \frac{\sin 2x}{4} \right] \Big|_0^{\frac{\pi}{2}} = \left[ x^2 \sin x + 2x \cos x - 2 \sin x + \frac{3x}{2} - \frac{\sin 2x}{4} \right] \Big|_0^{\frac{\pi}{2}}$$

$$= \left[ \frac{\pi^2}{4} + 0 - 2 + \frac{3\pi}{4} - 0 \right] - [0] = \frac{\pi^2}{4} + \frac{3\pi}{4} - 2$$

13. If  $|z+1| = \alpha z + \beta(1+i)$  and  $z = \frac{1}{2} - 2i$ , then the value of  $|\alpha + \beta|$  is equal to, where  $\alpha, \beta \in \mathbb{R}$

(1) 4

(2) 3

(3) 2

(4) 1

Ans. (2)

Sol.  $\left| \frac{3}{2} - 2i \right| = \left( \frac{\alpha}{2} - 2\alpha i \right) + \beta i + \beta$

$$2\alpha = \beta \text{ and } \frac{\alpha}{2} + \beta = \sqrt{\frac{9}{4} + 4}$$

$$\frac{\alpha}{2} + 2\alpha = \frac{5}{2}$$

$$\alpha = 1$$

$$\beta = 2 \text{ Ans. } |\alpha + \beta| = 3$$

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14. If mean and variance of observations 60, 60, 44, 58, 68, 56,  $\alpha$ ,  $\beta$  are 58 and 66.2 respectively then  $\alpha^2 + \beta^2$  is equal to  
(1) 6150.2 (2) 7181.6 (3) 9532.8 (4) 3252.6

Ans. (2)

Sol.  $\sigma^2 = \frac{\sum x_i^2}{8} - (\bar{x})^2 = 66.2$

$$\frac{60^2 + 60^2 + 44^2 + 58^2 + 68^2 + 56^2 + \alpha^2 + \beta^2}{8} - (58)^2 = 66.2$$

$$\frac{3600 + 3600 + 1936 + 3364 + 4624 + 3136 + \alpha^2 + \beta^2}{8} = 66.2 + 3364$$

$$20260 + \alpha^2 + \beta^2 = 8 \times (3430.2)$$

$$\alpha^2 + \beta^2 = 27441.6 - 20260$$

$$\alpha^2 + \beta^2 = 7181.6$$

15.  $\vec{a}, \vec{b}, \vec{c}$  are three pairwise non-collinear vectors.  $\vec{a} + 6\vec{b}$  is collinear with  $\vec{c}$ ,  $\vec{b} + 5\vec{c}$  is collinear with  $\vec{a}$ , then  $\vec{a} + \alpha\vec{b} + \beta\vec{c} = \vec{0}$ , then  $\alpha + \beta = ?$

- (1) 36 (2) 30 (3) 25 (4) 39

Ans. (1)

Sol.  $\vec{a} + 6\vec{b} = \lambda\vec{c}$

$$\vec{b} + 5\vec{c} = \mu\vec{a} \Rightarrow 6\vec{b} + 30\vec{c} = 6\mu\vec{a}$$

$$\vec{a} - 30\vec{c} = \lambda\vec{c} - 6\mu\vec{a}$$

$$(1 + 6\mu)\vec{a} = (\lambda + 30)\vec{c}$$

$\vec{a}$  and  $\vec{c}$  are non-collinear

Sol  $\lambda = -30$  and  $\mu = -\frac{1}{6}$

$$\text{So } \vec{a} + 6\vec{b} = -30\vec{c}$$

$$\vec{a} + 6\vec{b} + 30\vec{c} = \vec{0}$$

$$\therefore \alpha + \beta = 6 + 30 = 36$$

16. If  $\frac{dy}{dx} - \left( \frac{\sin 2x}{1 + \cos^2 x} \right) y = \frac{\sin x}{1 + \cos^2 x}$  and  $y(0) = 0$  then  $y\left(\frac{\pi}{2}\right)$  is

- (1) 2 (2) 1 (3) 5 (4) 3

Ans. (2)

Sol.  $\frac{dy}{dx} - \left( \frac{\sin 2x}{1 + \cos^2 x} \right) y = \frac{\sin x}{1 + \cos^2 x}$

$$\text{If } e^{-\int \frac{\sin 2x}{1 + \cos^2 x} dx} = e^{\ln(1 + \cos^2 x)} = 1 + \cos^2 x$$

So general solution of DE

$$y(1 + \cos^2 x) = \int \frac{\sin x}{1 + \cos^2 x} \cdot (1 + \cos^2 x) dx$$

$$y(1 + \cos^2 x) = -\cos x + c$$

$$y(1 + \cos^2 x) + \cos x = c$$

$$\text{where } y(0) = 0$$

$$0 + 1 = c$$

$$y(1 + \cos^2 x) + \cos x = 1$$

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

$$y\left(\frac{\pi}{2}\right) = \frac{1 - 0}{1 + 0} = 1$$

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17. If  $\int \frac{(\operatorname{cosec} x - \sin x)}{\operatorname{cosec} x \sec x + \tan x \sin^2 x} dx = f(x)$  and  $f(\pi/2) = 1$  then  $f(\pi/4)$

(1)  $1 + \frac{1}{\sqrt{2}} \tan^{-1} \frac{1}{2}$

(2)  $1 - \frac{1}{\sqrt{2}} \tan^{-1} \frac{1}{\sqrt{2}}$

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

(4)  $1 + \frac{1}{\sqrt{2}} \tan^{-1} \frac{1}{\sqrt{2}}$

Ans. (3)

Sol.  $\int \left( \frac{1 + \sin^2 x}{\frac{1}{\cos x} + \frac{\sin^4 x}{\cos x}} \right) dx$

$= \int \frac{(1 + \sin^2 x) \cos x}{1 + \sin^4 x} dx$

$\sin x = t, \quad \cos x dx = dt$

$\int \frac{1+t^2}{1+t^4} dt = \int \left( \frac{1 + \frac{1}{t^2}}{t^2 + \frac{1}{t^2}} \right) dt$

$= \int \frac{du}{u^2 + 2}$

$t - \frac{1}{t} = 4$

$= \frac{1}{\sqrt{2}} \tan^{-1} \frac{u}{\sqrt{2}} + c$

$\left(1 + \frac{1}{t^2}\right) dt = dx$

$f(x) = \frac{1}{\sqrt{2}} \tan^{-1} \left( \frac{\sin x - \frac{1}{\sin x}}{\sqrt{2}} \right) + c$

$f\left(\frac{\pi}{2}\right) = 1 \Rightarrow c = 1$

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

$f\left(\frac{\pi}{4}\right) = 1 - \frac{1}{\sqrt{2}} \tan^{-1} \frac{1}{2}$

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18.  $f(x) = \frac{(2^x + 2^{-x})(\tan x)\sqrt{\tan^{-1}(2x^2 - 3x + 1)}}{(7x^2 - 3x + 1)^3}$ , then find  $f'(0)$

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

Ans. (3)

Sol. RHD =  $\lim_{h \rightarrow 0} \frac{f(0+h) - f(0)}{h}$

$$= \lim_{h \rightarrow 0} \frac{(2^h + 2^{-h})\tanh\sqrt{\tan^{-1}(2h^2 - 3h + 1)} - 0}{(7h^2 - 3h + 1)^3} = (2^h + 2^{-h})\frac{\tanh\sqrt{\tan^{-1}(2h^2 - 3h + 1)}}{h(7h^2 - 3h + 1)^3}$$

$$= \frac{2 \times 1 \times \sqrt{\tan^{-1}1}}{1} = \frac{2\sqrt{\pi}}{2} = \sqrt{\pi}$$

similarly LHD =  $\sqrt{\pi}$

19. Statement- I:  $f(x) = 4\sqrt{2}x^3 - 3\sqrt{2}x - 1 = 0$  has only one solution in  $x \in \left(\frac{1}{2}, 1\right)$

Statement- II:  $\cos \frac{\pi}{12}$  is a solution of  $f(x) = 0$

- (1) Statement- 1 is true & Statement -2 is true (2) Statement- 1 is true & Statement -2 is false  
(3) Statement- 1 is false & Statement -2 is true (4) Statement- 1 is false & Statement -2 is false

Ans. (1)

Sol.  $f(x) = 4\sqrt{2}x^3 - 3\sqrt{2}x - 1$

$$f'(x) = 12\sqrt{2}x^2 - 3\sqrt{2}$$

$$f'(x) = 3\sqrt{2}(4x^2 - 1)$$

$$f'(x) = 3\sqrt{2}(2x+1)(2x-1)$$



In  $x \in \left(\frac{1}{2}, 1\right)$ ,  $f(x)$  is increasing

and  $f\left(\frac{1}{2}\right) < 0$  and  $f(1) > 0$  so only one solution in  $\left(\frac{1}{2}, 1\right)$

$$f(x) = \sqrt{2}(4x^3 - 3x) - 1 = 0$$

Put  $x = \cos \frac{\pi}{12}$

$$\sqrt{2}\left(4\cos^3 \frac{\pi}{12} - 3\cos \frac{\pi}{12}\right) - 1 = 0$$

$$\sqrt{2}\cos \frac{\pi}{4} - 1 = 0$$

It is true.

So both statement are true

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20. If  $A(\vec{a}) = 2\hat{i} + 2\hat{j} + \hat{k}$  &  $B(\vec{b}) = 2\hat{i} + 4\hat{j} + 4\hat{k}$ , find the length of angle bisector of  $\angle AOB$ .

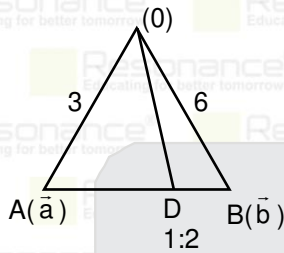
(1)  $\frac{1}{2}\sqrt{136}$

(2)  $\frac{1}{2}\sqrt{236}$

(3)  $\frac{1}{3}\sqrt{236}$

(4)  $\frac{1}{3}\sqrt{136}$

Sol. (4)



Position vector of  $D = \left( \frac{6\hat{i} + 8\hat{j} + 6\hat{k}}{3} \right)$

So  $|\vec{OD}| = \frac{1}{3}\sqrt{36 + 64 + 36} = \frac{1}{3}\sqrt{136}$

21. Area inside the curve  $x^2 + y^2 = 169$  and below the line  $5x - y = 13$  is

(1)  $\frac{169\pi}{4} - \frac{169}{2}\sin^{-1}\frac{12}{13} + \frac{65}{2}$

(2)  $\frac{169\pi}{4} + \frac{169}{2}\sin^{-1}\frac{12}{13} - \frac{65}{2}$

(3)  $\frac{169\pi}{4} - \frac{169}{2}\sin^{-1}\frac{12}{13} - \frac{65}{2}$

(4)  $\frac{169\pi}{4} + \frac{169}{2}\sin^{-1}\frac{12}{13} + \frac{65}{2}$

Ans. (2)

Sol.

Solving line & circle  $x = 0, 5$

$\tan\alpha = \frac{12}{5}$

$\sin\alpha = \frac{12}{13}$

$\sin\left(\frac{\pi}{2} + \alpha\right) = \cos\alpha = \frac{5}{13}$

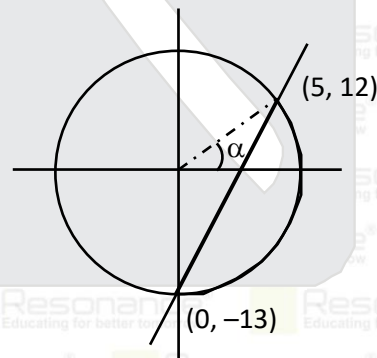
Now area of segment

$= \frac{1}{2}(r^2)(\theta - \sin\theta)$

$= \frac{1}{2} \times 169 \times \left[ \frac{\pi}{2} + \sin^{-1}\alpha - \sin\left(\frac{\pi}{2} + \alpha\right) \right]$

$= \frac{169}{2} \left[ \frac{\pi}{2} + \sin^{-1}\frac{12}{13} - \frac{5}{13} \right]$

$= \frac{169\pi}{4} + \frac{169}{2}\sin^{-1}\frac{12}{13} - \frac{65}{2}$



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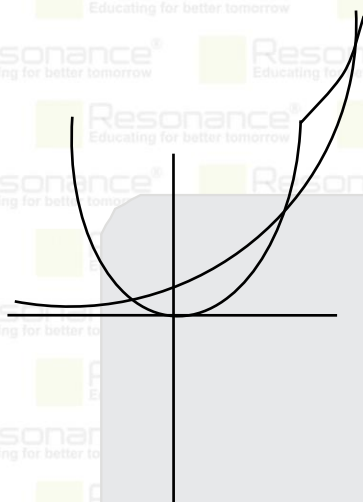
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22. If  $f(x) = 2^x - x^2$  and  $f(x) = 0$  has  $m$  solutions.  $f'(x) = 0$  has  $n$  solutions then  $m + n =$

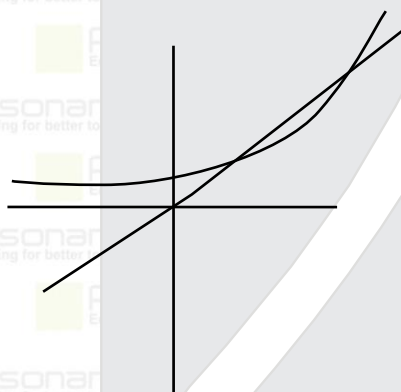
**Ans. (5)**

**Sol.**  $f(x) = 0 \Rightarrow 2^x = x^2$

number of solutions = 3



and



number of solutions of  
 $f'(x) = 0$

$$2^x \ln 2 = 2x$$

2 solutions






So total 5 solutions

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