JEE-Main-21-01-2026 (Memory Based)
[MORNING SHIFT]
Maths

Question:cosec 10° - $\sqrt{3}$ sec 10°
Options:
(a) 1
(b) 2
(c) 3
(d) 4
Answer: (d)

$$\text{cosec}10^o - \sqrt{3}\sec 10^o = \frac{1}{\sin 10^o} - \frac{\sqrt{3}}{\cos 10^o}$$

$$= \frac{\cos 10^o - \sqrt{3}\sin 10^o}{\sin 10^o \cos 10^o}$$

$$= \frac{2\left(\frac{1}{2}\cos 10^o - \frac{\sqrt{3}}{2}\sin 10^o\right)}{\frac{1}{2}.\sin 20^o}$$

$$= \frac{4\cos 70^o}{\sin 20^o} = 4$$

Question: If $A = \begin{bmatrix} \alpha & 2 \\ 1 & 2 \end{bmatrix}, B = \begin{bmatrix} 1 & 1 \\ \beta & 1 \end{bmatrix}$ **and A^2-4A + 2I = 0; B^2-2B + I = 0, then |adj(A^3- B^3)| is equal to**
Options:
(a) 11
(b) 7
(c) -11
(d) 121
Answer: (a)

$tr(A) = 4 \rightarrow \alpha = 2$

$|B| = 1 \rightarrow \beta = 0$

$$A^3 = \begin{bmatrix} 6 & 8 \\ 4 & 6 \end{bmatrix}\begin{bmatrix} 2 & 2 \\ 1 & 2 \end{bmatrix} = \begin{bmatrix} 20 & 28 \\ 14 & 20 \end{bmatrix}$$

$$B^3 = \begin{bmatrix} 1 & 3 \\ 0 & 1 \end{bmatrix}$$

$$\left|adj\left(A^3 - B^3\right)\right| = \left|A^3 - B^3\right| = \begin{vmatrix} 19 & 25 \\ 14 & 19 \end{vmatrix}$$

$= 361 - 350 = 11$

Question: If α and β are the roots of the equations $x^2 + x + 1 = 0$, then find $(\alpha + \beta)^4 + (\alpha^2 + \beta^2)^4 + (\alpha^3 + \beta^3)^4 + ... + (\alpha^{25} + \beta^{25})^4$

Options:
(a) 145
(b) 146
(c) 147
(d) 148
Answer: (a)

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

$$x = \frac{-1 \pm \sqrt{1-4}}{2}$$

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

$$x^2 + x + 1 = 0 \begin{matrix} \nearrow \omega \\ \searrow \omega^2 \end{matrix}$$

$$(\alpha + \beta)^4 = \left(\omega + \omega^2\right)^4 = 1$$

$$\left(\alpha^2 + \beta^2\right)^4 = \left(\omega^2 + \omega\right)^4 = 1$$

$$\left(\alpha^3 + \beta^3\right)^4 = \left(\omega^3 + \omega^6\right)^4 = 16$$

$$16 \times 8 + 1$$

$$= 145$$

Question: The value of $\int_0^{\frac{\pi}{2}} |\sin x + \sin 2x + \sin 3x| dx$ **is**
Options:
(a) $\frac{8}{3}$
(b) $\frac{7}{3}$
(c) $\frac{2}{3}$
(d) 3
Answer: (b)

$$\int_0^{\frac{\pi}{2}} |2 \sin 2x \cos x + \sin 2x| \, dx$$

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

$$I = \int_0^{\frac{\pi}{2}} \sin x + \sin 2x + \sin 3x \, dx$$

$$= -\cos x + \frac{-\cos 2x}{+2} + \frac{-\cos 3x}{+3} \Big|_0^{\frac{\pi}{2}}$$

$$= 1 + \left[\frac{1+1}{2}\right] + \left[\frac{0+1}{3}\right] = 1 + 1 + \frac{1}{3} = \frac{7}{3}$$

Question: If y = y(x) and $(1+x^2)$ dy + $(1- \tan^{-1}x)$dx = 0 and y(0) = 1 then y(1) is
Options:
(a) $\frac{\pi^2}{32} + \frac{\pi}{4} + 1$
(b) $\frac{\pi^2}{32} - \frac{\pi}{4} + 1$
(c) $\frac{\pi^2}{32} - \frac{\pi}{2} - 1$
(d) $\frac{\pi^2}{32} - \frac{\pi}{2} + 1$
Answer: (b)

$$dy + \frac{1+\tan^{-1}x}{1+x^2}dx = 0$$

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

$$y(1) + \frac{\pi}{4} - \frac{x^2}{32} = 1$$

$$y(1) = 1 + \frac{\pi^2}{32} - \frac{\pi}{4}$$

Question: The sum of roots of the equation $|x-1|^2$ -5 |x-1| + 6 = 0 is
Options:
(a) 4
(b) 3
(c) 1
(d) 5
Answer: (a)

Let $|x-1|^2 - 5|x-1| + 6 = 0$

Put $|x-1| = t$. Then

$t^2 - 5t + 6 = 0$

$(t-2)(t-3) = 0 \Rightarrow t = 2 \text{ or } t = 3$

So,

$|x-1| = 2 \Rightarrow x = 3, -1$

$|x-1| = 3 \Rightarrow x = 4, -2$

Sum of roots:

$3+(-1) + 4 + (-2) = \boxed{4}$

Question: If L_1 and L_2 are two parallel lines and ΔABC is an equilateral triangle then area of triangle ABC is
Options:
(a) $7\sqrt{3}$
(b) $4\sqrt{3}$

(c) $21\sqrt{3}$
(d) 84
Answer: (c)
$\sin\theta = \frac{6}{a}$

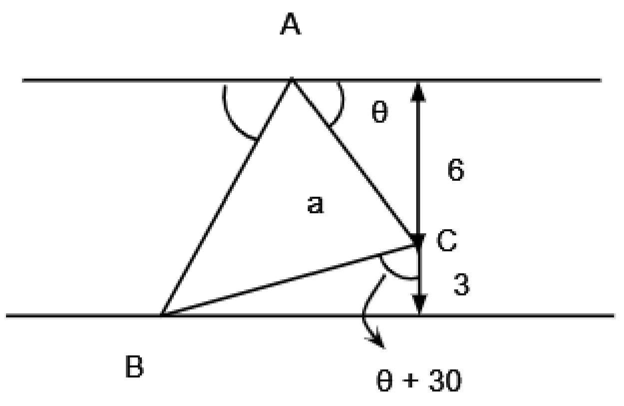
$\rightarrow \cos.\frac{\sqrt{3}}{2} - \sin\,\theta.\frac{1}{2} = \frac{3}{a}$

$\rightarrow \sqrt{1-\frac{6^2}{a^2}} \times \frac{\sqrt{3}}{2} = \frac{3}{a} + \frac{3}{a} = \frac{6}{a}$

$1 - \frac{36}{a^2} = \frac{36}{a^2} \times \frac{4}{3} = \frac{48}{a^2}$

$1 = \frac{84}{a^2} \rightarrow a^2 = 84$

$\text{Area} = \frac{\sqrt{3}}{4} \times 84 = 21\sqrt{3}$



Question: The Hyperbola and ellipse $\frac{x^2}{36} + \frac{y^2}{16} = 1$ have same foci and eccentricity of Hyperbola is 5 then length of latus rectum of hyperbola is
Options:
(a) $\frac{96}{\sqrt{5}}$
(b) $24\sqrt{5}$
(c) $18\sqrt{5}$
(d) $12\sqrt{5}$
Answer: (a)
Ellipse:

$\frac{x^2}{36} + \frac{y^2}{16} = 1 \Rightarrow c^2 = 36 - 16 = 20 \Rightarrow c = 2\sqrt{5}$

Hyperbola has same foci and e = 5:

$a = \frac{c}{e} = \frac{2\sqrt{5}}{5},\ a^2 = \frac{4}{5}$

For hyperbola:

$c^2 = a^2 + b^2 \Rightarrow b^2 = 20 - \frac{4}{5} = \frac{96}{5}$

Length of latus rectum:

$\text{LLR} = \frac{2b^2}{a} = \frac{2.\frac{96}{5}}{\frac{2\sqrt{5}}{5}} = \boxed{\frac{96\sqrt{5}}{5}}$

Question: The number of relations, defined on the set {a, b, c, d} which are both reflexive & symmetric is equal to

Options:

(a) 16

(b) 1024

(c) 64

(d) 256

Answer: (c)

No of relations both reflexive and
Symmetric = 26 = 64

Question: The locus of point of intersection of tangent drawn to the circle $(x - 2)^2 + (y - 3)^2 = 16$, which subtends an angle of 120° is

Options:

(a) $3x^2 + 3y^2 - 12x - 18y - 25 = 0$

(b) $x^2 + y^2 - 12x - 18y - 25 = 0$

(c) $3x^2 + 3y^2 + 12x + 18y - 25 = 0$

(d) $x^2 + y^2 + 12x + 18y$

Answer: (a)

For the circle

$(x-2)^2 + (y-3)^2 = 16$

the centre is (2,3) and radius r = 4.

If tangents drawn from a point P subtend an angle of 120°, then

$2\sin^{-1}\left(\frac{r}{OP}\right) = 120^\circ$

$\sin^{-1}\left(\frac{r}{OP}\right) = 60^\circ \Rightarrow \frac{r}{OP} = \frac{\sqrt{3}}{2}$

Hence,

$OP = \frac{2r}{\sqrt{3}} = \frac{8}{\sqrt{3}}$

Therefore, the locus of point P is a circle with centre(2,3)and radius $\frac{8}{\sqrt{3}}$.

$$\boxed{(x-2)^2 + (y-3)^2 = \frac{64}{3}}$$

$$3(x-2)^2 + 3(y-3)^2 = 64$$

$$3\left(x^2 - 4x + 4\right) + 3\left(y^2 - 6y + 9\right) = 64$$

$$\boxed{3x^2 + 3y^2 - 12x - 18y - 25 = 0}$$

Question: If $a_1, a_2, a_3, \ldots$ are in increasing geometric progression such that
$a_1 + a_3 + a_5 = 21$,
$a_1 a_3 a_5 = 64$ then $a_1 + a_2 + a_3$ is

Options:

(a) 5

(b) 7

(c) 10

(d) 15

Answer: (b)

$$a\,.\,ar^2.\;ar^4 = 64$$

$$\left(ar^2\right)^3 = 64$$

$$ar^2 = 4$$

$$a + ar^2 + ar^4 = 21$$

$$a + ar^4 = 17$$

$$a + a.\,\frac{16}{a^2} = 17$$

$$a + \frac{16}{a} = 17 \Rightarrow\; a = 1,\; r = 2$$

$$a_1 + a_2 + a_3 \;=\; 1 + 2 + 4 = 7$$

Question: In the expansion $(ax^2 + bx + c)\,(1 - 2x)^{26}$, if coefficient of x, x^2 & x^3 are -56, 0, 0 respectively, then find the value of a + b + c.

Options:

(a) 1500

(b) 1403

(c) 1300

(d) 1483

Answer: (b)

Coeff of x = -56

Coeff of x^2 = 0

Coeff of x^3 = 0

By applying binomial theorem on Given expression, we have

b $^{26}C_0$ + c $^{26}C_1(-2)$ = -56 ⇒ b- 52 C = - 56 …..(1)

a $^{26}C_0$ + $^{26}C_1(-2)$b + $^{26}C_2(-2)^2$ c = 0 ⇒ a - 52 b + 1300 c = 0 ……..(2)

c $^{26}C_3(-2)^3$ + b $^{26}C_2\,(-2)^2$ + a $^{26}C_1(-2)$ = 0 ⇒ a - 25 b + 400 C = 0 …..(3)

By (1) , (2) & (3)

$$\begin{bmatrix} 0 & 1 & -52 \\ 1 & -52 & 1300 \\ 1 & -25 & 400 \end{bmatrix}$$

$$\left[\begin{array}{ccc|c} 0 & 1 & -52 & -56 \\ 1 & -52 & 1300 & 0 \\ 1 & -25 & 400 & 0 \end{array}\right]$$

By applying row operations

(1) $R_1 \leftrightarrow R_2$

(2) $R_3 \leftrightarrow R_3 - R_1$

(3) $R_3 \to R_3 - 27R_2$

$$\to \left[\begin{array}{ccc|c} 1 & -52 & 1300 & 0 \\ 0 & 1 & -52 & -56 \\ 0 & 0 & 504 & 1512 \end{array}\right]$$

a = 1300

b = 100

c = 3

a+b+c = 1403

Question: Find the area inside the ellipse $x^2 + 4y^2 = 4$ and outside the area inclosed by the curves $y = |x| - 1$ & $y = 1 - |x|$.

Options:

(a) $2(\pi - 1)$

(b) $3(\pi - 1)$

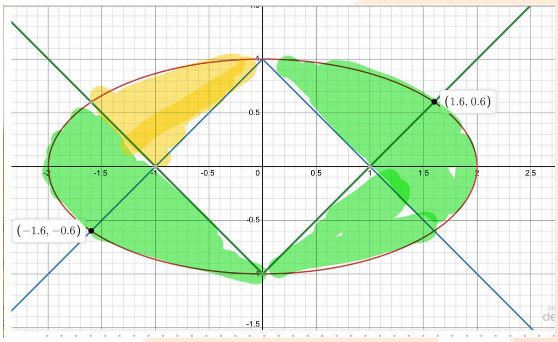
(c) $\pi - 1$

(d) $\frac{\pi - 1}{4}$

Answer: (a)

Shaded Area = $\pi(2)(1) - (\sqrt{2})^2$

$= 2\pi - 2 = 2(\pi - 1)$



Question: The value of the integral $\displaystyle\int_{-\frac{\pi}{6}}^{\frac{\pi}{6}} \frac{2\pi + 4x^{11}}{1 - \sin\left(|x| + \frac{\pi}{6}\right)} dx$

Options:

(a) π

(b) 2π

(c) 4π

(d) 8π

Answer: (d)

$$\int_{-\frac{\pi}{6}}^{\frac{\pi}{6}} \frac{2\pi + 4x^{11}}{1 - \sin\left(|x| + \frac{\pi}{6}\right)} dx$$

$$I = 2\int_{0}^{\frac{\pi}{6}} \frac{2\pi\, dx}{1 - \sin\left(|x| + \frac{\pi}{6}\right)} \text{ (second part is odd)}$$

$$t = x + \frac{\pi}{6}$$

$$I = 4\pi \int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \frac{dt \times (1 + \sin t)}{(1 - \sin t)(1 + \sin t)}$$

$$I = 4\pi \int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \left(\sec^2 t + \sec t \tan t\right) dt$$

$$I = 4\pi \left[\tan t + \sec t\right]_{\frac{\pi}{6}}^{\frac{\pi}{3}}$$

$$I = 4\pi \times 2 = 8\pi$$

Question: If A={1, 2, 3, 4, 5, 6), B = {1, 2, 3, ... 8, 9}. Then the number of strictly increasing functions from A → B such that f(i) $\neq$ i $\forall$ i = 1, 2, 3, 4, 5, 6 are

Options:

(a) 25

(b) 27

(c) 28

(d) 29

Answer: (c)

Case I : f(1) = 2

No. of functions = $^7C_5$

= 21

Case II : If f(1) = 3

No of functions = $^6C_5$ = 6

Case III : If f(1) = 4

No of functions = $^6C_6$ = 1

Total = 21 + 6 + 1 = 28

Question: If the mean and variance of observations x, y, 12, 14, 4, 10, 2 is 8 and 16 respectively where x > y. Then, the value of 3x - y is

Options:

(a) 18

(b) 20

(c) 22

(d) 24

Answer: (a)

$$\overline{X} = \frac{x+y+12+14+4+10+2}{7}$$

$$8 = \frac{x+y+42}{7}$$

$$x + y = 56 - 42$$

$$x + y = 14$$

$$a^2 = \overline{x^2} - (\overline{x})^2$$

$$16 = \frac{x^2+y^2 144+196+16+100+4}{7} - (8)^2$$

$$(16 + 64) \times 7 = x^2 + y^2 + 460$$

$$560 - 460 - x^2 + y^2$$

$x^2 + y^2 = 100$

$(x + y)^2 = 2xy = 100$

$(14)^2 - 2xy = 100$

$xy = 48$

$x + y = 14 \quad xy = 48$

$x + \frac{48}{x} \ = 14$

$x^2 - 14x + 48 = 0$

$x = 8, 6$

$y = 8, 6$

$x > y = 1 \, , \ x = 8_1 \, , \ y = 6$

$3x - y = 3 \times 8 - 6 = 18$

Question:If O is the vertex of the parabola $x^2 = 4y$, Q is the point on the parabola. If C is the locus of a point which divides OQ ratio 2:3. The equation of the chord of C which bisected at point (1, 2).

Options:

(a) 5x + 4y + 3 = 0

(b) 5x - 4y - 3 = 0

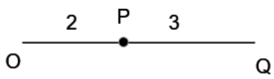
(c) 5x - 4y + 3 = 0

(d) 5x + 4y - 3 = 0

Answer: (c)

$x^2 = 4y$

$0(0,0) \quad Q(2t_1 t^2)$



$P = \left(\frac{4t}{5}, \frac{2t^2}{5}\right)$

$x = \frac{4t}{5}, \ y = \frac{2t^2}{5}$

$t = \frac{5x}{4}, \ y = \frac{2}{5}\left(\frac{5x}{4}\right)^2$

$y = \frac{5}{8}x^2$

$T = s_1 \ \rightarrow \ (1, \ 2)$

$\frac{y+2}{2} \ - \frac{5}{8}x(1) \ = 2 - \frac{5}{8}$

$5x - 4y + 3 = 0$

Question: If f(3) = 18, f'(3) = 0 and f''(3) = 4. Then, the value of

$\lim_{x \to 1} \ell n \left(\frac{f(x+2)}{f(3)} \right)^{\frac{18}{(x-1)^2}}$ **is equal to**

Options:

(a) 2

(b) 4

(c) 6

(d) 8

Answer: (a)

$$L=\log_e\left(\lim_{x\to 1}\left(\frac{f(x+2)}{f(3)}\right)^{\frac{18}{(x-1)^2}}\right)$$

1^{∞}form

$$L=\log_e\left(e^{\lim_{x\to 1}\frac{18}{(x-1)^2}\left(\frac{f(x+2)}{f(3)}-1\right)}\right)$$

$$L=\log_e\left(e^{\lim_{x\to 1}\frac{18}{(x-1)^2}\left(\frac{f(x+2)-f(3)}{f(3)}\right)}\right)$$

$$L=\log_e\left(e^{\lim_{x\to 1}\left[\frac{18(f(x+2)-18)}{(x-1)^2\,18}\right]}\right)$$

$$L=\log_e\left(e^{\lim_{x\to 1}\left[\frac{f(x+2)-18}{(x-1)^2}\right]}\right)$$

$$L=\log_e\left(e^{\lim_{x\to 1}\frac{f'(x+2)}{2(x-1)}}\right)$$

$$L=\log_e\left(e^{\lim_{x\to 1}\frac{f''(x+2)}{2}}\right)$$

$$L=\log_e\left(e^2\right)=2$$

Question: If $a_1 = 1$ and for $n \geq 1$, $a_{n+1}=\frac{1}{2}a_n\frac{n^2-2n-1}{n^2(n+1)^2}$ **then** $\left|\sum_{n=1}^{\infty}\left(a_n-\frac{2}{n^2}\right)\right|$

Options:

(a) 4

(b) 2

(c) 1

(d) 5

Answer: (b)

$$a_{n+1} = \frac{a_n}{2} + \frac{1}{(n+1)^2} - \left[\frac{(n+1)^2 - n^2}{n^2(n+1)^2}\right]$$

$$a_{n+1} = \frac{a_n}{2} + \frac{1}{(n+1)^2} - \left[\frac{1}{n^2} - \frac{1}{(n+1)^2}\right]$$

$$a_{n+1} - \frac{2}{(n+1)^2} = \frac{a_n}{2} - \frac{1}{n^2}$$

$$a_{n+1} - \frac{2}{(n+1)^2} = \frac{1}{2}\left(a_n - \frac{2}{n^2}\right)$$

$$b_{n+1} = \frac{1}{2} b_n \qquad b_n = a_n - \frac{2}{n^2}$$

$$b_2 = \frac{1}{2}(-1) = -\frac{1}{2} \qquad b_1 = 1 - \frac{2}{1} = -1$$

$$b_3 = \frac{1}{2}\left(\frac{-1}{2}\right) = -\frac{1}{4}$$

$$b_n = (-1)\left(\frac{1}{2}\right)^{n-1} = -\left(\frac{1}{2}\right)^{n-1}$$

$$a_n - \frac{2}{n^2} = -\left(\frac{1}{2}\right)^{n-1}$$

$$\left|\sum_{n=1}^{\infty}\left(a_n - \frac{2}{n^2}\right)\right| = \sum_{n=1}^{\infty}\left(\frac{1}{2}\right)^{n-1}$$

$$= 1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \ldots\ldots + \infty$$

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

Question: If the domain of the function

$\cos^{-1}\left(\dfrac{2x-5}{11x-7}\right) + \sin^{-1}(2x^2 - 3x + 1)$ is $[0,\, a],\ \left[\dfrac{12}{13},\, b\right]$ then $\dfrac{1}{ab}$

is equal to

Options:

(a) -3

(b) 3

(c) 2

(d) 4

Answer: (b)

$$-1 \le \frac{2x-5}{11x-7} \le 1, \quad -1 \le 2x^2 - 3x + 1 \le 1$$

$$\frac{2x-5}{11x-7} + 1 \ge 0,\ \frac{2x-5}{11x-7} - 1 \le 0,\ 2x^2 - 3x + 2 \ge 0,$$

$$2x^2 - 3x \le 0$$

$$\frac{13x-12}{11x-7} \ge 0,\ \frac{-9x+2}{11x-7} \le 0,\ x(2x-3) \le 0$$

$$x \in \left(-\infty, \frac{7}{11}\right) \cup \left[\frac{12}{13}, \infty\right),\ x \in \left(-\infty, \frac{2}{9}\right] \cup \left(\frac{7}{11}, \infty\right),\ x \in \left[0, \frac{3}{2}\right]$$

$$\Rightarrow x \in \left[\frac{12}{13}, \frac{3}{2}\right] \cup \left[0, \frac{2}{9}\right]$$

$$a = \frac{2}{9},\ b = \frac{3}{2} \Rightarrow ab = \frac{1}{3} \Rightarrow \frac{1}{ab} = 3$$