PAPER SOLUTION

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#Q. If $2x^2 + (cos\theta)x - 1 = 0, \theta \in [0, 2\pi]$ has roots α and β. Then the sum of maximum and minimum value of $\alpha^4 + \beta^4$ is

(A) $\frac{25}{16}$

(B) $\frac{9}{16}$

(C) $\frac{41}{16}$

(D) $\frac{8}{17}$

Ans. (A)

$2\sin^2\theta = 1 - 2\sin^2\theta$

$4\sin^2\theta = 1 \Rightarrow \sin\theta = \frac{1}{2}, -\frac{1}{2}$

#Q. If $\theta \in [0, 2\pi]$ satisfying the system of equation $2sin^2\theta = \cos 2\theta$ and $2cos^2\theta =\ 3\ sin\ \theta$. Then the sum

$2\cos^2\theta = 3 \times \frac{1}{2}$

$\cos^2\theta = \frac{3}{4}$

$\cos\theta = \frac{\sqrt{3}}{2}, -\frac{\sqrt{3}}{2}$

$\theta = \frac{\pi}{6}, \frac{5\pi}{6} \Rightarrow 2\theta = \frac{\pi}{3}, \frac{5\pi}{3}$

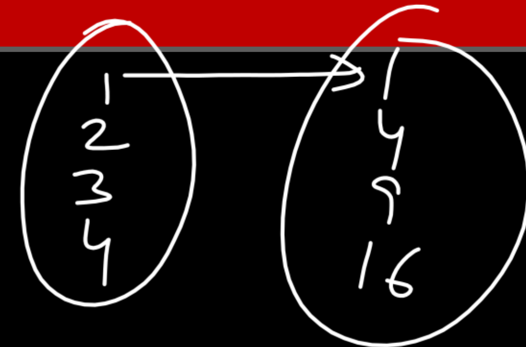
$\cos 2\theta =$

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

(B) π ✓

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

(D) $-\frac{5\pi}{6}$



#Q. Let A = {1,2,3,4} and B = {1,4,9,16},
If $f: A \to B$, then number of many-one function from A to B are

Total no. of functions = 4^4 = 256

No. of one-one function = $4 \times 3 \times 2 \times 1$ = 24

(A) 24

(B) 232 ✓

(C) 256

(D) 252

#Q. 4 boys and 3 girls are to be seated in a row such that all girls seat together and two particular boys B_1 *and* B_2 are not adjacent to each other. Then the number of ways in which this arrangement can be done

(A) 432 ✓

(B) 430

(C) 516

(D) 1002

✓ $(G_1G_2G_3)$ ✓ B_3 ✓ B_4 ✓

$3! \times 3! \times 4 \times 3$

$6 \times 6 \times 12$

$= 432$

$^nC_r = {}^nC_{n-r}$

$r \cdot {}^{30}C_r = r \cdot \frac{30}{r} \cdot {}^{29}C_{r-1} = 30 \cdot {}^{29}C_{r-1}$

#Q. If the sum $\sum_{r=1}^{30} \frac{r^2 \left({}^{30}C_r\right)^2}{{}^{30}C_{r-1}} = \alpha . 2^{29}$, then α is equal to

A 225

B 465 ✓

C 345

D 425

$(30)^2 \sum \frac{{}^{29}C_{r-1} \cdot {}^{29}C_{r-1}}{{}^{30}C_{r-1}}$

$30 \sum (31-r) \cdot {}^{29}C_{30-r}$

$30 \left[\sum (1+(30-r)) \, {}^{29}C_{30-r} \right]$

$\frac{{}^{29}C_{r-1}}{{}^{30}C_{r-1}} = \frac{\frac{29!}{(r-1)!(30-r)!}}{\frac{(30)!}{(r-1)!(31-r)!}} = \frac{31-r}{30}$

$$30\left[\sum\left(1+(30-r)\right)\,{}^{29}C_{30-r}\right]$$

$$= 30\left[\sum_{r=1}^{30} {}^{29}C_{30-r} + \sum_{r=1}^{29} (30-r)\cdot\frac{29}{30-r}\cdot {}^{28}C_{29-r}\right]$$

$$= 30\left[2^{29} + 29\cdot 2^{28}\right]$$

$$= 30\times 2^{28}\left[2+29\right] = 15\times 2^{29}\times 31 = 465\times 2^{29}$$

(2,1), (3,2), (3,1)

#Q. Let A = {1,2,3} then the number of relations on A which consist of ordered pair (1,2) & (2,3) and must be reflexive and transitive but not symmetric

{(1,1), (2,2), (3,3), (1,2), (2,3), (1,3)} → 1

(1,1), (2,2) (3,3), (2,1), (1,2), (2,3), (1,3)} → 1

(1,1), (2,2), (3,3), (3,2), (2,1), (1,2), (2,3), (1,3)}

(3,1)

$$^3C_1 + {}^3C_2 = 6$$

A) 6 ✓

B) 5

C) 4

D) 7

$\vec{a}\cdot\vec{b} = \frac{1}{2}$

#Q. Let $\vec{a}$ and $\vec{b}$ be two unit vectors such that angle between $\vec{a}$ and $\vec{b}$ is $\frac{\pi}{3}$. If $\lambda\vec{a} + 3\vec{b}$ and $2\,\vec{a} + \lambda\vec{b}$ are perpendicular to each other, then the product of all possible value of λ is

$(\lambda\vec{a} + 3\vec{b})\cdot(2\vec{a} + \lambda\vec{b}) = 0$

A) 6

B) 8

C) 7

D) 5

$2\lambda + \frac{\lambda^2}{2} + 3 + 3\lambda = 0$

$\lambda^2 + 10\lambda + 6 = 0$

$P = 6$

#Q. Consider a function $f(x) = \int_0^{x^2} \frac{t^2-8t+15}{e^t}\,dt$. The number of points of extrema are

$$f'(x) = \frac{x^4 - 8x^2 + 15}{e^{x^2}} \cdot (2x)$$

$$= \frac{(x^2-3)(x^2-5) \cdot 2x}{e^{x^2}}$$

$$= \frac{(x-\sqrt{3})(x+\sqrt{3})(x-\sqrt{5})(x+\sqrt{5}) \cdot 2x}{e^{x^2}}$$

(A) 3

(B) 5 ✓

(C) 7

(D) 9

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$\frac{1}{3}, \frac{1}{4}$

#Q. Let A and B are two events such that $P(A \cap B) = \frac{1}{10}$ and P(A/B) and P(B/A) are the roots of the equation $12x^2 - 7x + 1 = 0$, then $\frac{P(\overline{A} \cup \overline{B})}{(\overline{A} \cap \overline{B})}$ is equal to

A $\frac{4}{9}$ ✓

B $\frac{9}{4}$

C $\frac{3}{2}$

D $\frac{2}{3}$

$\frac{P(A \cap B)}{P(B)} = \frac{1}{3} \Rightarrow P(B) = \frac{3}{10}$

$\frac{P(A \cap B)}{P(A)} = \frac{1}{4} \Rightarrow P(A) = \frac{4}{10}$

$P(A \cup B) = \frac{4}{10} + \frac{3}{10} - \frac{1}{10} = \frac{6}{10}$

$\frac{P(\overline{A \cap B})}{P(\overline{A \cup B})} = \frac{1 - P(A \cup B)}{1 - P(A \cap B)}$

$= \frac{1 - \frac{6}{10}}{1 - \frac{1}{10}} = \frac{4}{9}$

$a_2 + a_4 + a_6 + \cdots + a_{2n} = 40$

$a_1 + a_3 + a_5 + \cdots + a_{2n-1} = 55$

$nd = -15$

#Q. Number of terms in an arithmetic progression is an arithmetic progression is 2n. Sum of terms occurring at even places is 40 and sum of terms occurring at odd places is 55. If the first term exceeds the last term by 27, then

$a_{2n} - a_1 = -27$

$(2n-1)d = -27$

$nd = -15$

$\frac{2n-1}{n} = \frac{9}{5}$

$10n - 5 = 9n$

$n = 5$

(A) 3

(B) 5

(C) 7

(D) 4

Ans. (B)

$$adj(adj\ A) = |A|^{n-2} A$$

#Q. If A is the 3×3 matrix of order 3×3, such that det(A)= $\frac{1}{2}$, tr (A) = 10 and be another matrix of order 3×3 and defined as B = adj(adj(2A)), then det (B)+tr(B) is equal to (where tr(A) denotes trace of matrix A)

$$B = |2A|.(2A)$$
$$= 2^3 \times \frac{1}{2}(2A)$$
$$B = 8A$$

$$|B| = |8A| = 8^3 \times \frac{1}{2} = 64 \times 4$$

$$tr(B) = 80$$

(A) 336

(B) 337

(C) 338

(D) 339

$$A \cdot \operatorname{adj}(A) = |A| I, \quad \frac{\operatorname{adj} A}{|A|} = A^{-1}$$

$$\frac{(\operatorname{adj} A)}{|A|} \cdot (\operatorname{adj}(\operatorname{adj} A)) = \frac{|\operatorname{adj} A| I}{|A|} = \frac{|A|^{n-1} I}{|A|}$$

$$A^{-1} \operatorname{adj}(\operatorname{adj} A) = |A|^{n-2} I$$

$$\boxed{\operatorname{adj}(\operatorname{adj} A) = |A|^{n-2} A}$$

#Q. If $x + y + 2z = 6$, $2x + 3y + az = a + 1$ & $-x - 3y + bz = 2b$ has infinitely many solution then 7a+3b=?

$2x$

$-14 + 30 = 16$

$-2y + (b+2)z = 2b + 6$

$y + (a-4)z = a - 11$

$-2 = \frac{2(b+2)}{2(a-4)} = \frac{2b+6}{a-11} = \frac{-(b+4)}{7} = \frac{-2}{a+3}$

$b + 4 = 14$

$b = +10$

$a + 3 = 1$

$a = -2$

A

B

C

D

Ans.(16)

$2\left[x^5 + 10x^3(x^3-1) + 5x(x^3-1)^2\right] = 2\left[x^5 + 10x^6 - 10x^3 + 5x^7 + 5x - 10x^4\right]$

$5x(x^6 - 2x^3 + 1)$

#Q. In the expansion of $\left(x+\sqrt{x^3-1}\right)^5 + \left(x-\sqrt{x^3-1}\right)^5$, where α, β, γ and δ are the coefficients of x x^3, x^5 and x^7 respectively. If $\alpha u - \beta v = 18$ and $\gamma u + \delta v = 20$, then u + v is equal to

(A) $-\frac{14}{15}$

(B) $-\frac{13}{15}$

(C) $-\frac{3}{5}$

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

$\alpha = 10,\ \beta = -20,\ \gamma = 2,\ \delta = 10$

$10u + 20v = 18$

$5u + 10v = 9$

$2u + 10v = 20$

$3u = -11$

$u = -\frac{11}{3}$

$-\frac{22}{3} + 10v = 20$

$v = \left(20 + \frac{22}{3}\right)\frac{1}{10}$

Ans. (A)

#Q. Let A(6,8), B($10\cos\alpha, -10\sin\alpha$) and $C(-10\sin\alpha, -10\cos\alpha)$ be 3 points and if orthocenter of the triangle ABC is (0,9), then $100\sin^2\alpha$ is equal to

A $\frac{25}{4}$ ✓

B 25

C $\frac{15}{4}$

D $\frac{5}{4}$

$6 + 10\cos\alpha - 10\sin\alpha = 0 \Rightarrow 10\cos\alpha - 10\sin\alpha = -6$

$8 - 10\sin\alpha - 10\cos\alpha = 9 \Rightarrow +10\cos\alpha + 10\sin\alpha = -1$

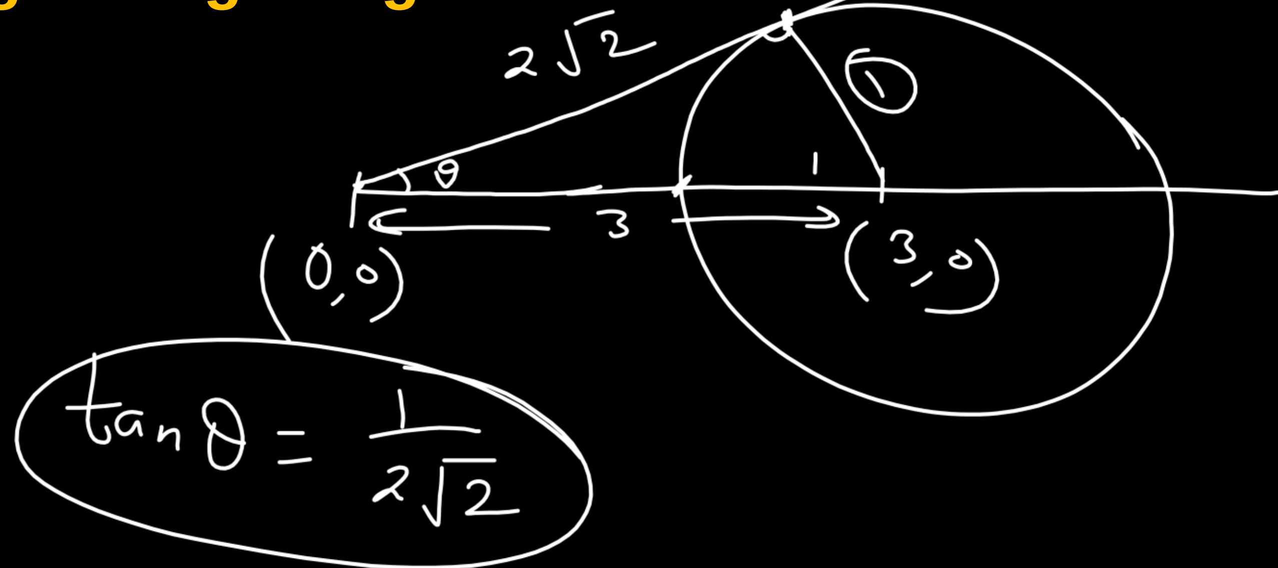
$10\sin\alpha + 10\cos\alpha = -1$

$-20\sin\alpha = -5$

$\sin\alpha = \frac{1}{4}$

$100\sin^2\alpha = 100 \times \frac{1}{16}$

#Q. If z be a complex number such that $|z-3| \leq 1$, then equation of the line with largest slope passing through origin and z



(A) $x - 2\sqrt{2}y = 0$

(B) $x + 2\sqrt{2}y = 0$

(C) $2\sqrt{2}x + y = 0$

(D) $2\sqrt{2}x - y = 0$

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#Q. $\int e^x\left(\frac{x\sin^{-1}x}{\sqrt{1-x^2}}+\left\{\frac{\sin^{-1}x}{(1-x^2)^{3/2}}+\frac{x}{1-x^2}\right\}\right)=g(x)+c$ Find $g\left(\frac{1}{2}\right)$

$$\int e^x\left(f(x)+f'(x)\right)dx=e^x f(x)+c.$$

A $\sqrt{e}\times\frac{\pi}{6\sqrt{3}}$

B

C

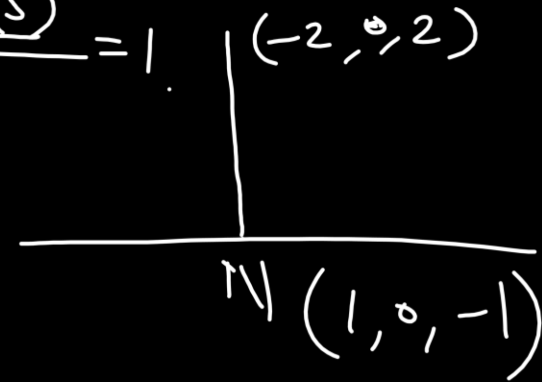
D

$$g(x)=e^x\,\frac{x\sin^{-1}x}{\sqrt{1-x^2}}$$

#Q. Perpendicular distance from the point $P(-2, 0, 2)$ to the line $\frac{x+1}{2} = \frac{y-1}{-1} = \frac{z+3}{2}$

$= \frac{2(-1)-1(-1)+2(5)}{4+1+4} = 1$

$x = 1, y = 0, z = -1$



A

B

C

D

Ans. $(3\sqrt{2})$

$k+6-2k$ $m = k+6.$ $k<6$

#Q. If the mean deviation about median for the number 3,5,7,2k,12,16,21,24, arranged in ascending order is 6 then the median is

$$8 \cdot M.D = (k+3)+(k+1)+(k-1)+(6-k)+(6-k)+(10-k)+(15-k)+(18-k)$$

$$48 = 58-2k$$

$$k = 5$$

A

B

C

D

Ans. (11)

$Q(-2, 1, 3)$ $\quad \sqrt{(12)^2 + 3^2 + 4^2} = 13$

#Q. Let $P(10, -2, -1)$ and Q be the point of perpendicular drawn from point R(1, 7, 6) on the line joining the points $(2, -5, 11)$ and $(-6, 7, -5)$. Then the length PQ is

$$\frac{x-2}{8} = \frac{y+5}{-12} = \frac{z-11}{16}$$

(A)

(B)

(C)

(D)

$$\frac{x-2}{2} = \frac{y+5}{-3} = \frac{z-11}{4} = \frac{2(-1) - 3(12) + 4(-5)}{4+9+16} = \frac{-58}{29} = -2$$

$x = -2,\ y = 1,\ z = 3.$

Ans. (13)

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#Q. Find the area bounded between these curves
$y = (x-2)^2$ and $y^2 = 16 - 8x$ is

(A)

(B)

(C)

(D)

Ans. (8/3)

#Q. If $\lim_{x\to\infty}\left(\left(\frac{e}{1-e}\right)\left(\frac{1}{e}-\frac{x}{1+x}\right)\right)^{x}=\alpha$, Find $\frac{ln\alpha}{1+ln\alpha}$

A

B

C

D

Ans, e