JEE Main 2020 Paper

Date : 4th September 2020

Time : 02 : 00 pm - 05 : 00 pm

Subject : Maths

Q.1 Suppose the vectors x_1, x_2 and x_3 are the solutions of the system of linear equations, Ax=b when the vector b on the right side is equal to b_1, b_2 and b_3 respectively. if

$$x_1 = \begin{bmatrix}1\\1\\1\end{bmatrix}, x_2 = \begin{bmatrix}0\\2\\1\end{bmatrix}, x_3 = \begin{bmatrix}0\\0\\1\end{bmatrix}, b_1 = \begin{bmatrix}1\\0\\0\end{bmatrix}, b_2 = \begin{bmatrix}0\\2\\0\end{bmatrix} \text{and } b_3 = \begin{bmatrix}0\\0\\2\end{bmatrix}$$

, then the determinant of A is equal to

(1) 2 (2) $\frac{1}{2}$ (3) $\frac{3}{2}$ (4) 4

Sol. **(1)**

Using AX = B

$$A = \begin{bmatrix} a_1 & a_2 & a_3 \\ a_4 & a_5 & a_6 \\ a_7 & a_8 & a_9 \end{bmatrix}_{3\times 3}$$

$$a_1 + a_2 + a_3 = 1 \quad 2a_2 + a_3 = 0$$
$$a_4 + a_5 + a_6 = 0 \quad 2a_5 + a_6 = 2$$
$$a_7 + a_8 + a_9 = 0 \quad 2a_8 + a_9 = 0$$

$$a_3 = 0, a_6 = 0, a_9 = 2$$

$$\therefore a_8 = -1, a_5 = 1, \quad a_2 = 0 \Rightarrow a_1 = 1, a_4 = -1, \quad a_7 = -1$$

$$A = \begin{bmatrix} 1 & 0 & 0 \\ -1 & 1 & 0 \\ -1 & -1 & 2 \end{bmatrix}$$

|A| = 2(1) = 2

Q.2 If a and b are real numbers such that $(2+\alpha)^4 = a + b\alpha$, where $\alpha = \frac{-1+i\sqrt{3}}{2}$ then a+b is equal to:

(1) 33 (2) 57 (3) 9 (4) 24

Sol. **(3)**

$$(2+\alpha)^4 = a + b\alpha$$

$$\left(2 + \frac{\sqrt{3}i - 1}{2}\right)^4 = a + b\alpha$$

$$\left(\frac{3+\sqrt{3}i}{2}\right)^4 = 9\left(\frac{\sqrt{3}}{2}+\frac{i}{2}\right)^4$$

$$9\left\{e^{i\pi/6}\right\}^4 = 9e^{i2\pi/3} = 9\left(\frac{-1}{2}+\frac{\sqrt{3}i}{2}\right) = \frac{-9}{2}+\frac{9\sqrt{3}}{2}i$$

$$-\frac{9}{2}+\frac{9\sqrt{3}}{2}i = a+b\left(\frac{-1}{2}+\frac{i\sqrt{3}}{2}\right)$$

$$= a-\frac{b}{2}+\frac{bi\sqrt{3}}{2}$$

$$\therefore \frac{b\sqrt{3}}{2} = \frac{9\sqrt{3}}{2} \Rightarrow b = 9$$

$a = 0 \therefore a + b = 9$

Q.3 The distance of the point (1, –2, 3) from the plane x–y+z=5 measured parallel to the line $\frac{x}{2}=\frac{y}{3}=\frac{z}{-6}$ is:

(1) $\frac{1}{7}$ (2) 7 (3) $\frac{7}{5}$ (4) 1

Sol. (4)

Equation of line through (1,-2,3) whose d.r.s. are (2,3,-6)

$$\frac{x-1}{2}=\frac{y+2}{3}=\frac{z-3}{-6}=\lambda$$

any point on line $(2\lambda+1, 3\lambda-2, -6\lambda+3)$

put in $(x-y+z=5)$

$$2\lambda+1-3\lambda+2-6\lambda+3=5$$

$$-7\lambda=-1$$

$$\lambda=\frac{1}{7}$$

distance $=\sqrt{(2\lambda)^2+(3\lambda)^2+(6\lambda)^2}$

$\sqrt{4\lambda^2+9\lambda^2+36\lambda^2} = 7\lambda = 1$ unit

Q.4 Let $f:(0,\infty)\to(0,\infty)$ be a differentiable function such that f(1) = e and $\lim\limits_{t\to x}\frac{t^2f^2(x)-x^2f^2(t)}{t-x}=0$. If f(x)=1,then x is equal to :

(1) e (2) 2e (3) $\frac{1}{e}$ (4) $\frac{1}{2e}$

Sol. **(3)**

$f(1)=e$ ...(1)

$\lim\limits_{t\to x}\frac{t^2f^2(x)-x^2f^2(t)}{t-x}=0$

L' Hospital

$\Rightarrow \lim\limits_{t\to x}\left(2tf^2(x)-2x^2f(t)\cdot f'(t)\right)=0$

$\Rightarrow 2xf^2(x)-2x^2f(x)\cdot f'(x)=0$

$\Rightarrow 2xf(x)\left\{f(x)-xf'(x)\right\}=0$

$\Rightarrow \frac{f'(x)}{f(x)}=\frac{1}{x}$

$\ln f(x)=\ln x+\ln c$

$\Rightarrow f(x)=cx$ ...(2)

if x = 1

f(1) = c(1)

f(1) = c

From eq.(1) & (2)

c = e ...(3)

From eq.(3)

f(x) = ex

$\Rightarrow$ y = ex or y = cx

$\therefore$ if f(x) = 1 $\Rightarrow$ x = $\frac{1}{e}$

Q.5 Contrapositive of the statement :

'If a function f is differentiable at a, then it is also continuous at a', is:

(1) If a function f is not continuous at a, then it is not differentiable at a.

(2) If a function f is continuous at a, then it is differentiable at a.

(3) If a function f is continuous at a, then it is not differentiable at a.

(4) If a function f is not continuous at a, then it is differentiable at a.

Sol. **(1)**

Contrapositive of p $\rightarrow$ q = ~q $\rightarrow$ ~p

Q.6 The minimum value of $2^{\sin x}+2^{\cos x}$ is:

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

Sol. **(2)**

Using A.M. $\geq$ G.M.

$y = 2^{\sin x} + 2^{\cos x}$

$$\frac{2^{\sin x}+2^{\cos x}}{2} \geq \sqrt{2^{\sin x+\cos x}}$$

$$2^{\sin x} + 2^{\cos x} \geq 2^1.2^{\frac{\sin x+\cos x}{2}}$$

$$2^{\sin x} + 2^{\cos x} \geq 2^{\frac{2+\sin x+\cos x}{2}}$$

$$\Rightarrow (2^{\sin x} + 2^{\cos x})_{\text{minimum}} = 2^{\frac{2-\sqrt{2}}{2}} = 2^{\frac{-1}{\sqrt{2}}+1}$$

Q.7 If the perpendicular bisector of the line segment joining the points P(1 ,4) and Q(k, 3) has y-intercept equal to −4, then a value of k is:

(1) −2 (2) $\sqrt{15}$ (3) $\sqrt{14}$ (4) −4

Sol. **(4)**

$$m_{PQ} = \frac{4-3}{1-k} \Rightarrow m_{\perp} = k-1$$

$$\text{mid point of } PQ = \left(\frac{k+1}{2}, \frac{7}{2}\right)$$

equation of perpendicular bisector

$$y - \frac{7}{2} = (k-1)\left(x - \frac{k+1}{2}\right)$$

for y intercept put x = 0

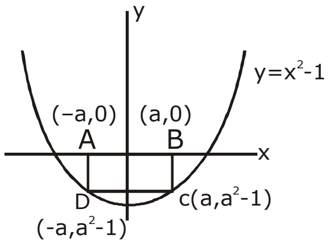
$$y = \frac{7}{2} - \left(\frac{k^2-1}{2}\right) = -4$$

$$\frac{k^2-1}{2} = \frac{15}{2} \Rightarrow k = \pm 4$$

Q.8 The area (in sq. units) of the largest rectangle ABCD whose vertices A and B lie on the x-axis and vertices C and D lie on the parabola, $y = x^2 - 1$ below the x-axis, is:

(1) $\frac{2}{3\sqrt{3}}$ (2) $\frac{4}{3}$ (3) $\frac{1}{3\sqrt{3}}$ (4) $\frac{4}{3\sqrt{3}}$

Sol. **(4)**



$$\text{Area} = 2a\left(a^2-1\right)$$

$$A = 2a^3 - 2a$$

$$\frac{dA}{da} = 6a^2 - 2 = 0$$

$$\frac{d^2A}{da^2} = 12a,\ \text{at } a = -\frac{1}{\sqrt{3}}$$

$$\frac{d^2A}{da^2} = -4\sqrt{3} < 0$$

$$\text{So Area is maximum at } a = -\frac{1}{\sqrt{3}}$$

$$A_{max} = \frac{-2}{3\sqrt{3}} + \frac{2}{\sqrt{3}} = \frac{-2+6}{3\sqrt{3}} \text{ sq.units}$$

Q.9 The integral $\int_{\pi/6}^{\pi/3} \tan^3 x.\sin^2 3x(2\sec^2 x.\sin^2 3x + 3\tan x.\sin 6x)dx$ is equal to:

(1) $\frac{9}{2}$ (2) $-\frac{1}{18}$ (3) $-\frac{1}{9}$ (4) $\frac{7}{18}$

Sol. **(2)**

$$I = \int_{\pi/6}^{\pi/3} 2.\tan^3 x\sec^2 x\sin^4 3x + 3\tan^4 x \sin^2 3x.\ 2\sin 3x\cos 3x\ dx$$

$$= \frac{1}{2}\int_{\pi/6}^{\pi/3} 4\tan^3 x\sec^2 x\sin^4 3x + 3.4\tan^4 x\sin^3 3x\cos 3x dx$$

$$= \frac{1}{2}\int_{\pi/6}^{\pi/3} \frac{d}{dx}\left(\tan^4 x\sin^4 3x\right)dx$$

$= \frac{1}{2}\left[\tan^4 x \sin^4 3x\right]_{\pi/6}^{\pi/3}$

$= \frac{1}{2}\left[9.(0) - \frac{1}{3}.\frac{1}{3}(1)\right] = -\frac{1}{18}$

Q.10 If the system of equations
x+y+z=2
2x+4y–z=6
3x+2y+λz=μ
has infinitely many solutions, then

(1) $\lambda - 2\mu = -5$ (2) $2\lambda + \mu = 14$ (3) $\lambda + 2\mu = 14$ (4) $2\lambda - \mu = 5$

Sol. **(2)**

D = 0 $\begin{vmatrix} 1 & 1 & 1 \\ 2 & 4 & -1 \\ 3 & 2 & \lambda \end{vmatrix} = 0$

$(4\lambda + 2) - 1(2\lambda + 3) + 1(4 - 12) = 0$

$4\lambda + 2 - 2\lambda - 3 - 8 = 0$

$2\lambda = 9 \Rightarrow \lambda = \frac{9}{2}$

$D_x = \begin{vmatrix} 2 & 1 & 1 \\ 6 & 4 & -1 \\ \mu & 2 & 9/2 \end{vmatrix} = 0$

$\Rightarrow \mu = 5$
Now check option
$2\lambda + \mu = 14$

Q.11 In a game two players A and B take turns in throwing a pair of fair dice starting with player A and total of scores on the two dice, in each throw is noted. A wins the game if he throws a total of 6 before B throws a total of 7 and B wins the game if he throws a total of 7 before A throws a total of six. The game stops as soon as either of the players wins. The probability of A winning the game is:

(1) $\frac{5}{31}$ (2) $\frac{31}{61}$ (3) $\frac{30}{61}$ (4) $\frac{5}{6}$

Sol. **3**

sum total 7 = {(1,6)(2,5)(3,4)(4,3)(5,2)(6,1)}

P(sum 7) = $\frac{6}{36}$

sum total 6 = {(1,5)(2,4)(3,3)(4,2)(5,1)}

P(sum 6) = $\frac{5}{36}$

$P(A_{win}) = P(6) + P(\overline{6}).P(\overline{7}).P(6) + ...$

$$= \frac{5}{36} + \frac{31}{36} \times \frac{30}{36} \times \frac{5}{36} + \ldots\ldots$$

$$= \frac{\frac{5}{36}}{1 - \frac{31\times30}{36\times36}} = \frac{5\times36}{36\times36 - 31\times30}$$

$$= \frac{5\times36}{366} = \frac{30}{61}$$

Q.12 If for some positive integer n, the coefficients of three consecutive terms in the binomial expansion of $(1+x)^{n+5}$ are in the ratio 5:10:14, then the largest coefficient in this expansion is :

(1) 792 (2) 252 (3) 462 (4)330

Sol. **3**

$T_r : T_{r+1} : T_{r+2}$

$^{n+5}C_{r-1} : ^{n+5}C_r : ^{n+5}C_{r+1} = 5:10:14$

$$\frac{(n+5)!}{(r-1)!(n+6-r)!} : \frac{(n+5)!}{r!(n+5-r)!} = \frac{5}{10}$$

$$\frac{r}{n+6-r} = \frac{1}{2} \qquad \frac{(r+1)!(n+4-r)!}{r!(n+5-r)!} = \frac{5}{7}$$

2r = n + 6 – r

3r = n + 6 ...(1)

$$\frac{r+1}{n+5-r} = \frac{5}{7}$$

7r+7 = 5n + 25-5r

12r = 5n + 18 ..(2)

From eq.(1) & (2)

∴ 4(n + 6) = 5n + 18

n = 6, r = 4

Then we can $(1 + x)^{11}$

Largest coefficient in the expansion $(1 + x)^{11} = {}^{11}C_6 = 462$

Q.13 The function $f(x) = \begin{cases} \frac{\pi}{4} + \tan^{-1} x, & |x| \le 1 \\ \frac{1}{2}(|x| - 1), & |x| > 1 \end{cases}$ is :

(1) both continuous and differentiable on R–{–1}

(2) continuous on R–{–1} and differentiable on R–{–1,1}

(3) continuous on R–{1} and differentiable on R–{–1,1}

(4) both continuous and differentiable on R–{1}

Sol. **(3)**

f(x) = $\begin{cases} \frac{\pi}{4}+\tan^{-1}x & x\in[-1,1] \\ \frac{1}{2}(x-1) & x>1 \\ \frac{1}{2}(-x-1) & x<-1 \end{cases}$

at x = 1

f(1) = $\frac{\pi}{2}$ f(1^+) = 0

$\therefore$ discontinuous $\Rightarrow$ non diff.
at x = – 1

f(–1) = 0 f(-1^-) = $\frac{1}{2}\{+1-1\}$ = 0

cont. at x = – 1

f′(x) = $\begin{cases} \frac{1}{1+x^2} & x\in[-1,1] \\ \frac{1}{2} & x>1 \\ -\frac{1}{2} & x<-1 \end{cases}$

at x = –1,

f′(-1^-) = $-\frac{1}{2}$ and f′(-1^+) = $\frac{1}{2}$
So, at x = –1 it is non differentiable.

Q.14 The solution of the differential equation $\frac{dy}{dx}-\frac{y+3x}{\log_e(y+3x)}+3=0$ is:
(where c is a constant of integration)

(1) $x-\log_e(y+3x)= C$

(2) $x-\frac{1}{2}(\log_e(y+3x))^2 = C$

(3) $x-2\log_e(y+3x)=C$

(4) $y+3x-\frac{1}{2}(\log_e x)^2 = C$

Sol. **(2)**

$$\frac{dy}{dx}-\frac{y+3x}{\ell n(y+3x)}+3=0$$

$$\Rightarrow\left(\frac{dy}{dx}+3\right)=\frac{y+3x}{\ell n(y+3x)}$$

Let ln(y + 3x) = t

$$\frac{1}{y+3x}\cdot\left(\frac{dy}{dx}+3\right)=\frac{dt}{dx}$$

$$\therefore\ (y+3x)\frac{dt}{dx}=\frac{y+3x}{t}$$

$\Rightarrow$ tdt = dx

$$\frac{t^2}{2}=x+c$$

$$\frac{1}{2}\left(\ln(y+3x)\right)^2 = x + c$$

Q.15 Let $\lambda \neq 0$ be in R. If α and β are the roots of the equation, $x^2 - x + 2\lambda = 0$ and α and γ are the roots of the equation, $3x^2 - 10x + 27\lambda = 0$, then $\frac{\beta\gamma}{\lambda}$ is equal to:

(1) 27 (2) 9 (3) 18 (4) 36

Sol. **(3)**

$x^2 - x + 2\lambda = 0\ (\alpha,\beta)$

$$3x^2-10x+27\lambda=0(\alpha,\gamma)$$

$$3x^2-3x+6\lambda=0$$

$-\quad+\quad-$

$$-7x+21\lambda=0$$

$\therefore\ \alpha = 3\lambda$ Put in equation

$9\lambda^2 - 3\lambda + 2\lambda = 0$

$9\lambda^2 - \lambda = 0 \Rightarrow \lambda=\frac{1}{9} \Rightarrow \alpha=\frac{1}{3}$

$\alpha.\beta = \frac{2}{9} \Rightarrow \beta = \frac{2}{3}$

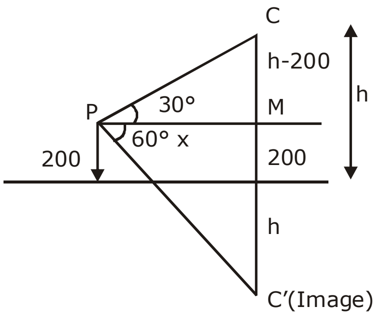
$\alpha.\gamma = 1 \Rightarrow \gamma = 3$

$$\therefore\ \frac{\beta.\gamma}{\lambda} \Rightarrow \frac{\frac{2}{3}.3}{\frac{1}{9}} = 18$$

Q.16 The angle of elevation of a cloud C from a point P, 200 m above a still lake is 30°. If the angle of depression of the image of C in the lake from the point P is 60°,then PC (in m) is equal to :

(1) $200\sqrt{3}$ (2) $400\sqrt{3}$ (3) 400 (4) 100

Sol. **(3)**



$$\frac{h-200}{x} = \tan 30° \qquad \frac{h+200}{x} = \tan 60°$$

$$\frac{h+200}{h-200} = 3$$

h + 200 = 3h – 600

2h = 800

h = 400

$$\therefore \frac{h-200}{PC} = \sin 30°$$

PC = 400 m

Q.17 Let $\bigcup_{i=1}^{50} X_i = \bigcup_{i=1}^{n} Y_i = T$, where each X_i contains 10 elements and each Y_i contains 5 elements. If each element of the set T is an element of exactly 20 of sets X_i's and exactly 6 of sets Y_i's, then n is equal to :

(1) 15 (2) 30 (3) 50 (4) 45

Sol. **(2)**

Number of elements set T = $\bigcup_{i=1}^{50} X_i = \bigcup_{i=1}^{n} Y_i$

$$\Rightarrow \frac{50\times 10}{20} = \frac{n\times 5}{6}$$

$$\Rightarrow \frac{50}{2}\times\frac{6}{5} = n$$

$\Rightarrow$ n = 30

Q.18 Let x=4 be a directrix to an ellipse whose centre is at the origin and its eccentricity is $\frac{1}{2}$. If P(1, β), β > 0 is a point on this ellipse, then the equation of the normal to it at P is :

(1) 8x–2y=5 (2) 4x–2y=1 (3) 7x–4y=1 (4) 4x–3y=2

Sol. **(2)**

e = $\frac{1}{2}$ x = $\frac{a}{e} = 4$

$\Rightarrow$ a = 2

$e^2 = 1-\frac{b^2}{a^2} \Rightarrow \frac{1}{4} = 1-\frac{b^2}{4}$

$\frac{b^2}{4}=\frac{3}{4} \Rightarrow b^2 = 3$

$\therefore$ Ellipse $\frac{x^2}{4}+\frac{y^2}{3}=1$

P(1,β)

$x = 1 \; ; \; \frac{1}{4}+\frac{\beta^2}{3}=1$

$\frac{\beta^2}{3}=\frac{3}{4} \Rightarrow \beta=\frac{3}{2}$

$\Rightarrow P\left(1,\frac{3}{2}\right)$

Equation of normal $\frac{a^2x}{x_1}-\frac{b^2y}{y_1}=a^2-b^2$

$\frac{4x}{1}-\frac{3y}{\frac{3}{2}} = 4 - 3$

$4x - 2y = 1$

Q.19 Let $a_1, a_2, ..., a_n$ be a given A.P. whose common difference is an integer and $S_n=a_1+a_2+ .... +a_n$. If $a_1=1$, $a_n=300$ and $15 \le n \le 50$, then the ordered pair (S_{n-4}, a_{n-4}) is equal to:

(1) (2480,248) (2) (2480,249) (3) (2490,249) (4) (2490,248)

Sol. **4**

$a_1 = 1$, $a_n = 300$, $15 \le n \le 50$

$300 = 1 + (n - 1)d$

$(n - 1) = \frac{299}{d}$

n − 1 = integer, d has to be a factor of 299.

So, d = 23 or 13

if d = 23

then n − 1 = 13

n = 14 (reject)

or d = 13

n − 1 = 23

n = 24

is possible ($15 \le n < 50$)

or $S_{20} = \frac{20}{2}\{2+19.13\}$

$a_{20} = 1 + 19.13$

$a_{20} = 248$

$= 10\{249\} = 2490$

$(S_{20}, a_{20}) = (2490, 248)$

Q.20 The circle passing through the intersection of the circles, $x^2+y^2-6x=0$ and $x^2+y^2-4y=0$, having its centre on the line, $2x-3y+12=0$, also passes through the point:

(1) (−1,3) (2) (1,−3) (3) (−3,6) (4) (−3,1)

Sol. **(3)**

$S_1 + \lambda(S_1 - S_2) = 0$

$x^2 + y^2 - 6x + \lambda(4y - 6x) = 0$

$x^2 + y^2 - 6x(1 + \lambda) + 4\lambda y = 0$

Centre $(3(1 + \lambda), - 2\lambda)$ put in $2x - 3y + 12 = 0$

$6 + 6\lambda + 6\lambda + 12 = 0$

$12\lambda = - 18$

$\lambda = - 3/2$

$\therefore$ Circle is $x^2 + y^2 + 3x - 6y = 0$

Check options

Q.21 Let $\{x\}$ and $[x]$ denote the fractional part of x and the greatest integer $\le$ x respectively of a real number x. If $\int_0^n \{x\}dx, \int_0^n [x]dx$ and $10(n^2-n), (n \in N, n > 1)$ are three consecutive terms of a G.P., then n is equal to_____

Sol. **21**

$$\int_0^n \{x\}\, dx = n\int_0^1 x\, dx = n\left(\frac{x^2}{2}\right)_0^1 = \frac{n}{2}$$

$$\int_0^n [x]dx = \int_0^1 0 + \int_1^2 1\,dx + \int_2^3 2dx....+\int_{n-1}^n (n-1)dx$$

$$\Rightarrow 1 + 2 + ...+ n - 1 = \frac{n(n-1)}{2}$$

$$\Rightarrow \frac{n}{2}, \frac{n(n-1)}{2}, 10(n^2-n) \to G.P$$

$$\Rightarrow \frac{n^2(n-1)^2}{4} = \frac{n}{2}.10.n(n-1)$$

$\Rightarrow n - 1 = 20$

$\Rightarrow n = 21$

Q.22 A test consists of 6 multiple choice questions, each having 4 alternative answers of which only one is correct. The number of ways, in which a candidate answers all six questions such that exactly four of the answers are correct, is ______

Sol. **135**

$^6C_4 \times 1 \times 3^2 = 15 \times 9 = 135$

Q.23 If $\vec{a} = 2\hat{i} + \hat{j} + 2\hat{k}$, then the value of $\left|\hat{i} \times \left(\vec{a} \times \hat{i}\right)\right|^2 + \left|\hat{j} \times \left(\vec{a} \times \hat{j}\right)\right|^2 + \left|\hat{k} \times \left(\vec{a} \times \hat{k}\right)\right|^2$ is equal to____

Sol. **18**

$$\left|\hat{i} \times \left(\vec{a} \times \hat{i}\right)\right|^2 = \left|\vec{a} - \left(a.\hat{i}\right)\hat{i}\right|^2$$

$$= \left|\hat{j} + 2\hat{k}\right|^2 = 1 + 4 = 5$$

Similarly

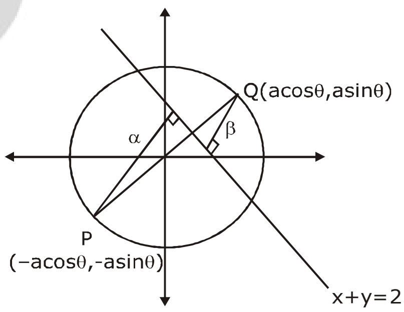
$$\left|\hat{j} \times \left(\vec{a} \times \hat{j}\right)\right|^2 = \left|2\hat{i} + 2\hat{k}\right|^2 = 4 + 4 = 8$$

$$\left|\hat{k} \times \left(\vec{a} \times \hat{k}\right)\right|^2 = \left|2\hat{i} + \hat{j}\right|^2 = 4 + 1 = 5$$

$\Rightarrow 5 + 8 + 5 = 18$

Q.24 Let PQ be a diameter of the circle $x^2+y^2=9$. If α and β are the lengths of the perpendiculars from P and Q on the straight line, $x+y=2$ respectively, then the maximum value of $\alpha\beta$ is _____

Sol. **7**



$$\alpha = \left|\frac{3\cos\theta + 3\sin\theta - 2}{\sqrt{2}}\right|$$

$$\beta = \left|\frac{+3\cos\theta + 3\sin\theta + 2}{\sqrt{2}}\right|$$

$$\alpha\beta = \left|\frac{\left(3\cos\theta + 3\sin\theta\right)^2 - 4}{2}\right|$$

$$\Rightarrow \alpha\beta = \left|\frac{9 + 9\sin 2\theta - 4}{2}\right| \Rightarrow \alpha\beta = \left|\frac{5 + 9\sin 2\theta}{2}\right|$$

$$\alpha\beta_{\max} = \frac{9+5}{2} = 7$$

JEE Main 2020 Paper

Q.25 If the variance of the following frequency distribution :

Class	:	10–20	20–30	30–40
Frequency	:	2	x	2

is 50, then x is equal to____

Sol. **4**

L.H.S. = $\dfrac{\sum f_i(x_i-\overline{x})^2}{\sum f_i}-\left(\dfrac{\sum f_i(x_i-\overline{x})}{\sum f_i}\right)^2$

x_i	f_i	$x_i-\overline{x}$	$(x_i-\overline{x})^2$	$f_i(x_i-\overline{x})^2$
15	2	–10	100	200
25	x	0	0	0
35	2	10	100	200
	$4+x$			400

$\overline{x}=\dfrac{100+25x}{4+x}$

$\overline{x}$ = 25

$\therefore\ \dfrac{400}{4+x}$ = 50

x = 4