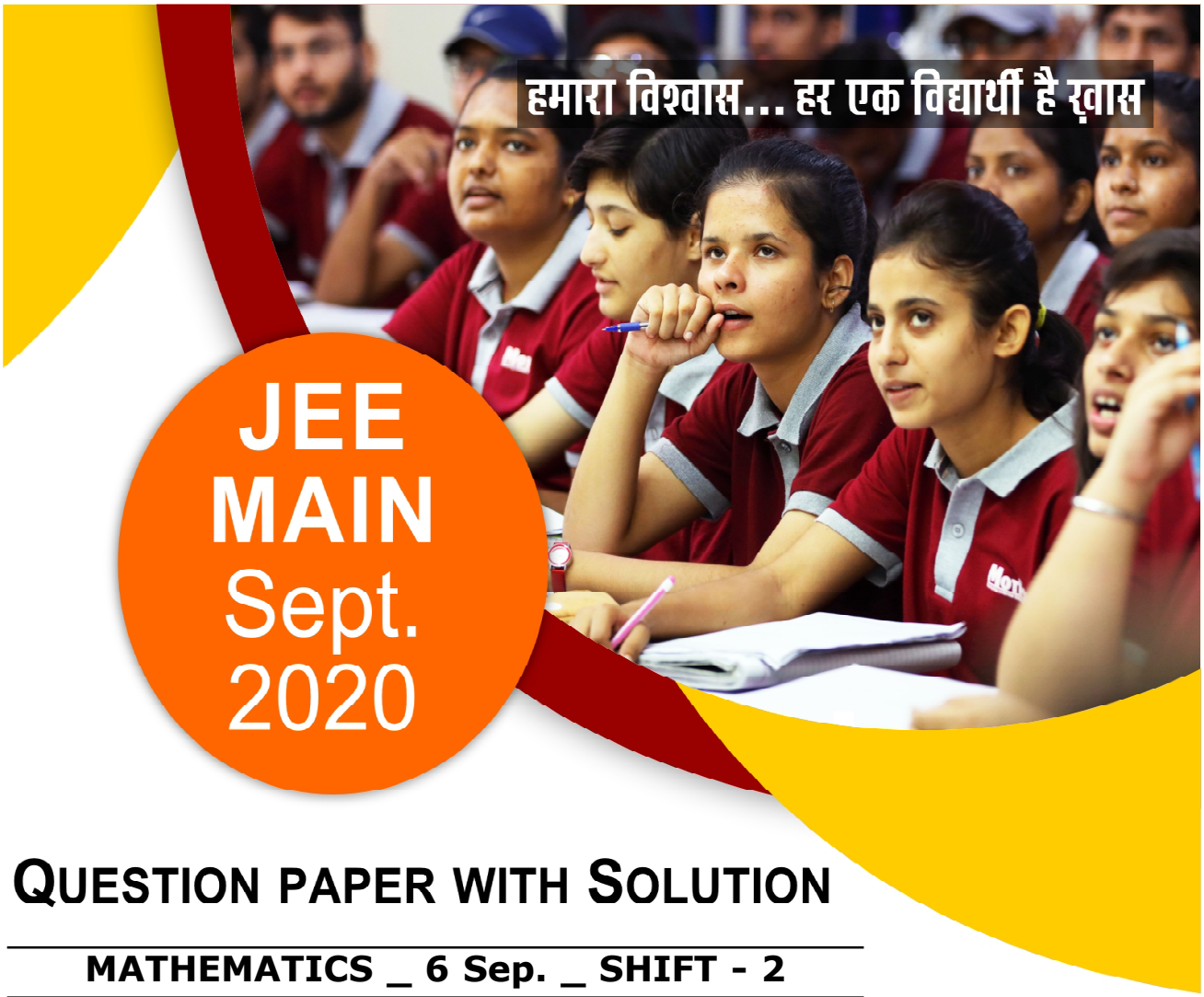

JEE MAIN Sept. 2020

QUESTION PAPER WITH SOLUTION

MATHEMATICS _ 6 Sep. _ SHIFT - 2

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Q.1 If the normal at an end of a latus rectum of an ellipse passes through an extremity of the minor axis, then the eccentricity e of the ellipse satisfies:
यदि एक दीर्घवत्त की नाभिलम्ब जीवा के एक किनारे पर अभिलम्ब लघु अक्ष के एक शीर्ष से होकर जाता है, तो दीर्घवत्त की उत्केन्द्रता e सन्तुष्ट करती है :
(1) $e^4+2e^2-1=0$ (2) $e^2+2e-1=0$ (3) $e^4+e^2-1=0$ (4) $e^2+e-1=0$

Sol. **(3)**

Equation of normal at $\left(ae, \frac{b^2}{a}\right)$

$$\frac{a^2x}{ae} - \frac{b^2y}{\frac{b^2}{a}} = a^2 - b^2$$

It passes through (0,–b)
$ab = a^2e^2$
$a^2(a^2(1-e^2)) \Rightarrow a^4e^4$

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

$$\Rightarrow e^4 + e^2 - 1 = 0$$

Q.2 The set of all real values of λ for which the function $f(x) = (1-\cos^2 x).(\lambda + \sin x)$, $x \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$, has exactly one maxima and exactly one minima, is:

λ के सभी वास्तविक मानों, जिनके लिए फलन $f(x) = (1-\cos^2 x).(\lambda + \sin x), x \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ का केवल एक उच्चिष्ठ (maxima) तथा केवल एक निम्निष्ठ (minima) है, का समुच्चय है:

(1) $\left(-\frac{3}{2}, \frac{3}{2}\right) - \{0\}$ (2) $\left(-\frac{1}{2}, \frac{1}{2}\right) - \{0\}$ (3) $\left(-\frac{3}{2}, \frac{3}{2}\right)$ (4) $\left(-\frac{1}{2}, \frac{1}{2}\right)$

Sol. **(1)**
$f(x) = (1-\cos^2x)(\lambda + \sin x)$
$f(x) = \sin^2x(\lambda + \sin x)$
$f'(x) = 2\sin x \cos x(\lambda + \sin x) + \sin^2x(\cos x)$

$$= \sin 2x\left(\lambda + \sin x + \frac{\sin x}{2}\right)$$

$$= \sin 2x\left(2\lambda + 3\sin x\right)$$

$\sin 2x = 0 \Rightarrow \sin x = 0 \rightarrow$ One point
$2\lambda + 3\sin x = 0$

$$\Rightarrow \sin x = \frac{-2\lambda}{3}$$

$\sin x \in (-1,1) - \{0\}$

$-1 < \frac{-2\lambda}{3} < 1 \Rightarrow \frac{-3}{2} < \lambda < \frac{3}{2}$

$\lambda \in \left(\frac{-3}{2}, \frac{3}{2}\right) - \{0\}$

Q.3 The probabilities of three events A, B and C are given by P(A)=0.6, P(B)=0.4 and P(C)=0.5. If $P(A \cup B)=0.8$, $P(A \cap C)=0.3$, $P(A \cap B \cap C)=0.2$, $P(B \cap C)=\beta$ and $P(A \cup B \cup C)=\alpha$, where $0.85 \le \alpha \le 0.95$, then β lies in the interval:

तीन घटनाओं A, B तथा C की प्रायिकताएं P(A)=0.6, P(B)=0.4 तथा P(C)=0.5 द्वारा दी गई है। यदि $P(A \cup B)=0.8$, $P(A \cap C)=0.3$, $P(A \cap B \cap C)=0.2$, $P(B \cap C)=\beta$ तथा $P(A \cup B \cup C)=\alpha$ जहाँ $0.85 \le \alpha \le 0.95$, तो β निम्न में से किस अंतराल में है ?

(1) [0.36,0.40] (2) [0.25,0.35] (3) [0.35,0.36] (4) [0.20,0.25]

Sol. **(2)**

$P(A \cup BUC) = P(A) + P(B) + P(C) - P(A \cap B) - P(B \cap C) - P(C \cap A) + P(A \cap B \cap C)$

$\alpha = 0.6 + 0.4 + 0.5 - P(A \cap B) - \beta - 0.3 + 0.2$

$\alpha = 1.4 - P(A \cap B) - \beta \Rightarrow \alpha + \beta = 1.4 - P(A \cap B)$ .....(1)

again

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$0.8 = 0.6 + 0.4 - P(A \cap B)$

$P(A \cap B) = 0.2$ .....(2)

Put the value $P(A \cap B)$ in equation (1)

$\alpha + \beta = 1.2$

$\alpha = 1.2 - \beta$

$0.85 \le \alpha \le 0.95 \Rightarrow 0.85 \le 1.2 - \beta \le 0.95$

$\beta \in [0.25, 0.35]$

Q.4 The common difference of the A.P. $b_1, b_2, \ldots b_m$ is 2 more than the common difference of A.P. $a_1, a_2, \ldots a_n$. If $a_{40} = -159$, $a_{100} = -399$ and $b_{100} = a_{70}$, then b_1 is equal to:

समान्तर श्रेढ़ी $b_1, b_2, \ldots b_m$ का सार्वअन्तर, समान्तर श्रेढ़ी $a_1, a_2, \ldots a_n$ के सार्वअन्तर से 2 अधिक है। यदि $a_{40} = -159$, $a_{100} = -399$ तथा $b_{100} = a_{70}$ तो b_1 बराबर है :

(1) −127 (2) 81 (3) 127 (4) −81

Sol. **(4)**

A.P $(a_1, a_2, a_3 \ldots\ldots\ldots a_n)$ (CD = Da)

$(b_1, b_2, b_3 \ldots\ldots\ldots b_m)$ (CD = Da + 2)

$D_b = D_a + 2$

$a_{40} = -159$

$a_1 + 39\, D_a = -159$ ----(1)

$a_{100} = -399$

$a_1 + 99\, D_a = -399$ ----(2)

Eqn (1) − (2)

$-60\ D_a = 240 \Rightarrow D_a = -4$
$D_b = -4 + 2 = -2$
$a_1 + 39(-4) = -159 \Rightarrow a_1 = -3$
$b_{100} = a_{70}$
$b_1 + 99\ D_b = a_1 + 69\ D_a$
$b_1 + 99\ (-2) = (-3) + 69(-4)$
$b_1 = -81$

Q.5 The integral $\int_1^2 e^x.x^x(2+\log_e x)dx$ equal :

समाकलन $\int_1^2 e^x.x^x(2+\log_e x)dx$ बराबर है:

(1) $e(4e-1)$ (2) $e(4e+1)$ (3) $4e^2-1$ (4) $e(2e-1)$

Sol. **(1)**

$$\int_1^2 e^x.x^x\ (2+\ln x)\ dx$$

$e^x.\ x^x = t$ ∵ Upper Limt = $e^2.2^2$, Lower Limit = e
$(e^x.x^x + e^x x^x(1+\ln x))\ dx = dt$
$e^x\ .\ x^x\ (2 + \ln x)\ dx\ = dt$

$$\int_e^{4.e^2} dt\ =\ [t]_e^{4.e^2}\ = 4.e^2 - e = e(4e-1)$$

Q.6 If the tangent to the curve, $y=f(x)=x\log_e x$, $(x>0)$ at a point $(c,f(c))$ is parallel to the line-segment joining the points $(1,0)$ and (e,e), then c is equal to:
यदि वक्र $y=f(x)=x\log_e x$, $(x>0)$ के एक बिन्दु $(c,f(c))$ पर स्पर्शरेखा बिन्दुओं $(1,0)$ तथा (e,e) को मिलाने वाले रेखाखण्ड के समान्तर है, तो c बराबर है:

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

Sol. **(4)**
$y = f(x) = x\ln x$

$$m_1 = \frac{dy}{dx}\Big|_{(c_1,f(c))} = (\ln x+1)\Big|_{(c_1,f(c))} = \ln c + 1$$

slope of the line joing (1, 0), (e, e)

$$m_1 = \frac{e}{e-1}\ ,\ m_2 = \left(\frac{e}{e-1}\right)$$

$$m_2 = m_1 \Rightarrow \ln c + 1 = \frac{e}{e-1}$$

$\ln c = \frac{e}{e-1} - 1 = \frac{1}{e-1}$

$\boxed{c = e^{(1/e-1)}}$

Q.7 If $y = \left(\frac{2}{\pi}x - 1\right)$ cosecx is the solution of the differential equation, $\frac{dy}{dx} + p(x)y = \frac{2}{\pi}\text{cosecx}, 0 < x < \frac{\pi}{2}$, then the function p(x) is equal to:

यदि अवकल समीकरण $\frac{dy}{dx} + p(x)y = \frac{2}{\pi}\text{cosecx}, 0 < x < \frac{\pi}{2}$, का हल $y = \left(\frac{2}{\pi}x - 1\right)$ cosec x है, तो फलन p(x) बराबर है:

(1) cosec x (2) cot x (3) tan x (4) sec x

Sol. **2**

$y = \left(\frac{2}{\pi}x - 1\right)$ cosecx

Differentiate w.r.t x

$\frac{dy}{dx} = \frac{2}{\pi}$ cosecx $-\left(\frac{2x}{\pi} - 1\right)$cosecx. cotx

$\frac{dy}{dx} + \left(\frac{2x}{\pi} - 1\right)$ cosecx cotx = $\frac{2}{\pi}$ cosecx

$\frac{dy}{dx} + y$ cotx = $\frac{2}{\pi}$ cosecx

Compare this differential equation with given differential equation

p(x) = cotx

Q.8 If α and β are the roots of the equation 2x(2x+1)=1, then β is equal to:

यदि α तथा β समीकरण 2x(2x+1)=1 के मूल है, तो β बराबर है :

(1) $2\alpha(\alpha - 1)$ (2) $-2\alpha(\alpha + 1)$ (3) $2\alpha^2$ (4) $2\alpha(\alpha + 1)$

Sol. **(2)**

2x(2x+1) = 1

If α & β are the roots i.e α & β satisy this equation

$2\alpha(2\alpha + 1) = 1 \quad \Rightarrow \quad \alpha(2\alpha + 1) = \frac{1}{2}$

$4x^2 + 2x - 1 = 0$

$\alpha + \beta = \frac{-1}{2} = -\alpha(2\alpha + 1)$

$\beta = -\alpha(2\alpha + 1) - \alpha = -\alpha(2\alpha + 2) = -2\alpha(\alpha + 1)$

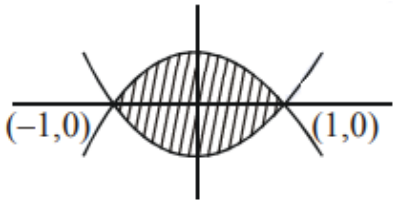
Q.9 For all twice differentiable functions f: R $\to$ R, with f(0)=f(1)=f'(0)=0,
(1) f''(x)=0, at every point $x \in (0,1)$ (2) f''(x) $\neq$ 0, at every point $x \in (0,1)$
(3) f''(x)=0, for some $x \in (0,1)$ (4) f''(0)=0
प्रत्येक द्वितीय अवकलनीय फलन f: R $\to$ R जिसके लिए f(0)=f(1)=f'(0)=0 है, तो :
(1) प्रत्येक बिन्दु $x \in (0,1)$ पर f''(x)=0, (2) प्रत्येक बिन्दु $x \in (0,1)$ पर f''(x) $\neq$ 0
(3) किसी $x \in (0,1)$ के लिए f''(x)=0 (4) f''(0)=0

Sol. **(3)**
Applying rolle's theorem in [0,1] for function f(x)
f'(c) = 0, c $\in$ (0,1)
again applying rolles theorem in [0,c] for function f'(x) s
f"(c_1) = 0, $c_1 \in (0,c)$

Q.10 The area (in sq.units) of the region enclosed by the curves $y=x^2-1$ and $y=1-x^2$ is equal to :
वक्रों $y=x^2-1$ तथा $y=1-x^2$ द्वारा घिरे क्षेत्र का क्षेत्रफल (वर्ग इकाइयों में) है :

(1) $\frac{4}{3}$ (2) $\frac{7}{2}$ (3) $\frac{16}{3}$ (4) $\frac{8}{3}$

Sol. **(4)**



Total area = $4\int_0^1 (1-x^2)dx = 4\left[x-\frac{x^3}{3}\right]_0^1$

$= 4\left[1-\frac{1}{3}\right] = \frac{8}{3} sq.unit$

Q.11 For a suitably chosen real constant a, let a function, f:R–{–a} $\to$ R be defined by $f(x)=\frac{a-x}{a+x}$.
Further suppose that for any real number $x \neq -a$ and f(x) $\neq$ –a, (fof)(x)=x.Then $f\left(-\frac{1}{2}\right)$ is equal to:
एक उपयुक्त वास्तविक अचर a चुनकर फलन f:R–{–a} $\to$ R, $f(x)=\frac{a-x}{a+x}$ द्वारा परिभाषित किया गया है। इसके अतिरिक्त माना किसी वास्तविक संख्या $x \neq -a$ तथा f(x) $\neq$ –a के लिए (fof)(x)=x है, तो $f\left(-\frac{1}{2}\right)$ निम्न में से किसके बराबर है ?

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

Sol. **(2)**

$f(x) = \frac{a-x}{a+x}$

$f(f(x)) = \frac{a-f(x)}{a+f(x)} = x$

$\frac{a-ax}{1+x} = f(x) = \frac{a-x}{a+x}$

$a\left(\frac{1-x}{1+x}\right) = \frac{a-x}{a+x}$

$\Rightarrow a = 1$

So $f(x) = \frac{1-x}{1+x}$

$f\left(\frac{-1}{2}\right) = 3$

Q.12 Let $\theta = \frac{\pi}{5}$ and $A = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$. If $B=A+A^4$, then det (B):

(1) is one (2) lies in (1,2) (3) lies in (2,3) (4) is zero

माना $\theta = \frac{\pi}{5}$ तथा $A = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$ हैं। यदि $B=A+A^4$, तो det (B):

(1) 1 के बराबर है। (2) अंतराल (1, 2) में है। (3) अंतराल (2,3) में है। (4) 0 के बराबर है।

Sol. **(2)**

$A = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$

$B = A + A^4$

$A^2 = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$

$= \begin{bmatrix} \cos^2\theta - \sin^2\theta & 2\sin\theta\cos\theta \\ -2\sin\theta\cos\theta & -\sin^2\theta + \cos^2\theta \end{bmatrix}$

$A^2 = \begin{bmatrix} \cos 2\theta & \sin 2\theta \\ -\sin 2\theta & \cos 2\theta \end{bmatrix}$

Simmilarly

$A^4 = \begin{bmatrix} \cos 4\theta & \sin 4\theta \\ -\sin 4\theta & \cos 4\theta \end{bmatrix}$

$$B = A^4 + A = \begin{bmatrix} \cos 4\theta & \sin 4\theta \\ -\sin 4\theta & \cos 4\theta \end{bmatrix} + \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$$

$$B = A^4 + A = \begin{bmatrix} \cos 4\theta + \cos\theta & \sin 4\theta + \sin\theta \\ -\sin 4\theta - \sin\theta & \cos 4\theta + \cos\theta \end{bmatrix}$$

$B = (\cos4\theta + \cos\theta)^2 + (\sin4\theta + \sin\theta)^2$
$= \cos^2 4\theta + \cos^2\theta + 2\cos4\theta\cos\theta$
$+ \sin^2 4\theta + \sin^2\theta + 2\sin4\theta - \sin\theta$
$= 2 + 2(\cos4\theta\cos\theta + \sin4\theta\sin\theta)$
$= 2 + 2\cos3\theta$

at $\theta = \frac{\pi}{5}$

$|B| = 2 + 2\cos\frac{3\pi}{5} = 2 - (1-\sin18)$

$|B| = 2\left(1-\frac{\sqrt{5}-1}{4}\right) = 2\left(\frac{5-\sqrt{5}}{4}\right) = \frac{5-\sqrt{5}}{2}$

Q.13 The centre of the circle passing through the point (0,1) and touching the parabola $y=x^2$ at the point (2,4) is :
बिन्दु (0,1) से होकर जाने वाले तथा परवलय $y=x^2$ को बिन्दु (2,4) पर स्पर्श करने वाले वत्त का केन्द्र है:

(1) $\left(\frac{3}{10},\frac{16}{5}\right)$ (2) $\left(\frac{6}{5},\frac{53}{10}\right)$ (3) $\left(\frac{-16}{5},\frac{53}{10}\right)$ (4) $\left(\frac{-53}{10},\frac{16}{5}\right)$

Sol. **(3)**
Circle passing through point (0,1) and touching curve
$y = x^2$ at (2,4)
tangent at (2,4) is

$$\frac{(y+4)}{2} = x(2)$$

$\Rightarrow y - 4x + 4 = 0$
Equation of circle
$(x-2)^2 + (y-4)^2 + \lambda(4x-y-4) = 0$
Passing through (0,1)
$4 + 9 + \lambda(-5) = 0$

$\lambda = \frac{13}{5}$

Circle is

$x^2-4x + 4 + y^2 - 8y + 16 + \frac{13}{5}[4x - y - 4] = 0$

$x^2 + y^2 + \left(\frac{52}{5} - 4\right)x - \left(8 + \frac{13}{5}\right)y + 20 - \frac{52}{5} = 0$

$x^2+y^2+\frac{32}{5}x-\frac{53}{5}y+\frac{48}{5}=0$

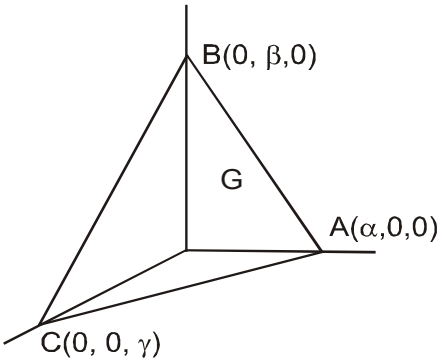
Centre is $\left(-\frac{16}{5},\frac{53}{10}\right)$

Q.14 A plane P meets the coordinate axes at A, B and C respectively. The centroid of ΔABC is given to be (1,1,2). Then the equation of the line through this centroid and perpendicular to the plane P is:
एक समतल P निदेशांक अक्षों को क्रमशः A, B तथा C पर मिलता है। यदि ΔABC का केन्द्रक (1,1,2) है, तो इस केन्द्रक से जाने वाली तथा समतल P के लम्बवत रेखा का समीकरण है:

(1) $\frac{x-1}{2}=\frac{y-1}{1}=\frac{z-2}{1}$ (2) $\frac{x-1}{2}=\frac{y-1}{2}=\frac{z-2}{1}$

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

Sol. (2)



$G=\left(\frac{\alpha}{3},\frac{\beta}{3},\frac{\gamma}{3}\right)=(1,1,2)$

$\alpha=3, \beta=3, \gamma=6$

Equation of plane is

$\frac{x}{\alpha}+\frac{y}{\beta}+\frac{z}{\gamma}=1$

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

$2x+2y+z=6$

Require line is $\frac{x-1}{2}=\frac{y-1}{2}=\frac{z-2}{1}$

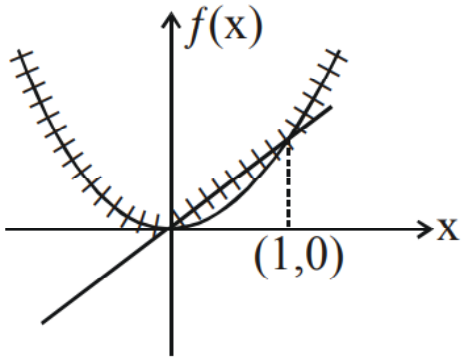
Q.15 Let $f : R \to R$ be a function defined by f(x)=max $\{x,x^2\}$. Let S denote the set of all points in R, where f is not differentiable. Then

माना $f : R \to R$, f(x)=max $\{x,x^2\}$ द्वारा परिभाषित एक फलन है। माना S, R के उन सभी बिन्दुओं जहाँ f अवकलनीय नहीं है, का समुच्चय है। तो :

(1) {0,1} (2) ϕ (an empty set)

(3) {1} (4) {0}

Sol. **(1)**



Function is not differentiable at two point

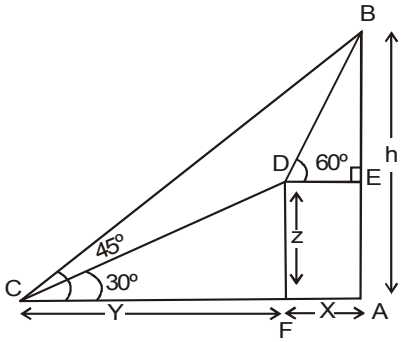
$\{0,1\}$

Q.16 The angle of elevation of the summit of a mountain from a point on the ground is 45°. After climbing up one km towards the summit at an inclination of 30° from the ground, the angle of elevation of the summit is found to be 60°. Then the height (in km) of the summit from the ground is:

भूमि पर एक बिन्दु से एक पर्वत के शिखर का उन्नयन कोण 45° है। भूमि से 30° के झुकाव पर शिखर की तरफ एक km चढ़ने पर, शिखर का उन्नयन कोण 60° पाया गया । तो शिखर की भूमि से ऊँचाई (km में) है:

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

Sol. **(4)**



If Δ CDF

$\text{Sin}30^\circ = \frac{z}{1} \Rightarrow Z = \frac{1}{2}$ km

$\cos 30^\circ = \frac{y}{1} \Rightarrow y = \frac{\sqrt{3}}{2}$ km

Now in ΔABC

$\tan 45^\circ = \frac{h}{x+y} \Rightarrow h = x + y$

$x = h - \frac{\sqrt{3}}{2}$

Now in ΔBDE

$\tan 60^\circ = \frac{h-z}{x}$

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

$\sqrt{3}\left(h - \frac{\sqrt{3}}{2}\right) = h - \frac{1}{2} \Rightarrow h = \frac{1}{\sqrt{3}-1}$ km

Q.17 If the constant term in the binomial expansion of $\left(\sqrt{x} - \frac{k}{x^2}\right)^{10}$ is 405, then |k| equals:

यदि $\left(\sqrt{x} - \frac{k}{x^2}\right)^{10}$ के द्विपद प्रसार में अचर पद 405 है, तो |k| बराबर है:

(1) 1 (2) 9 (3) 2 (4) 3

Sol. (4)

$10C_r \left(\frac{-k}{x^2}\right)^r \left(\sqrt{x}\right)^{10-r}$

$^{10}C_r (-k)^r (x)^{5-\frac{5r}{2}}$

For constant term

$5 - \frac{5r}{2} = 0 \Rightarrow r = 2$

$T_3 = {}^{10}C_2 k^2 = 405$

$k^2 = \frac{405}{45} = \frac{81}{9} = 9$

$|k| = 3$

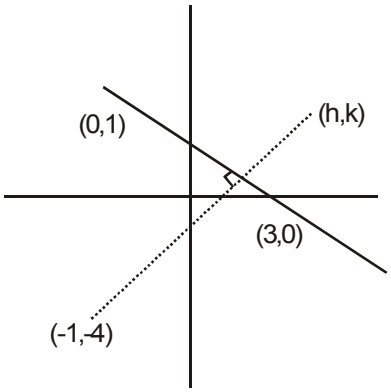
Q.18 Let z=x+iy be a non-zero complex number such that $z^2 = i|z|^2$, where $i = \sqrt{-1}$, then z lies on the
(1) line, y=x (2) real axis (3) imaginary axis (4) line, y=–x
माना कि एक अशून्य सम्मिश्र संख्या z=x+iy इस प्रकार है कि $z^2 = i|z|^2$ जहाँ $i = \sqrt{-1}$, तो z निम्न में से किस पर स्थित है :
(1) रेखा y=x (2) वास्तविक अक्ष (3) काल्पनिक अक्ष (4) रेखा, y=–x

Sol. **(1)**
$z = x + iy$
$z^2 = i\,|z|^2$
$x^2 - y^2 + 2i\,x\,y = i(x^2 + y^2)$
$x^2 - y^2 = 0 \Rightarrow x^2 = y^2$
$2xy = x^2 + y^2$
$(x - y)^2 = 0 \Rightarrow x = y$

Q.19 Let L denote the line in the xy-plane with x and y intercepts as 3 and 1 respectively. Then the image of the point (–1, –4) in this line is:
माना xy- समतल में L उस रेखा को प्रदर्शित करता है जिसके x तथा y अन्तःखण्ड क्रमशः 3 तथा 1 हैं। तो इस रेखा में बिन्दु (–1, –4) का प्रतिबिम्ब है:
(1) $\left(\frac{11}{5}, \frac{28}{5}\right)$ (2) $\left(\frac{8}{5}, \frac{29}{5}\right)$ (3) $\left(\frac{29}{5}, \frac{11}{5}\right)$ (4) $\left(\frac{29}{5}, \frac{8}{5}\right)$

Sol. **(1)**

$\frac{x}{3} + \frac{y}{1} = 1$
$x + 3y = 3$
L_2: $3x - y + \lambda = 0$
$-3 + 4 + \lambda = 0$
$\lambda = -1$
$3x - y = 1$
(h,k) satisfy the equation of line L_2
$3h - k = 1$ _____(1)



$\left|\frac{-1 - 12 - 3}{\sqrt{1+9}}\right| = \left|\frac{h + 3k - 3}{\sqrt{1+9}}\right|$

$16 = |h + 3k - 3|$
$h + 3k = 19$ _____(2)
$h + 3k = -13$ _____(3)
From equation (2) & (3) put the value of h in equation (1)
$h = 19 - 3k$, $h = -13 - 3k$
$3(19 - 3k) - k = 1$ $3(-13 - 3k) - k = 1$

$-10k = -56 = \frac{28}{5}$ $-10k = 40 \Rightarrow k = -4$

$k = \frac{28}{5}, h = 19 - 3\left(\frac{28}{5}\right) = \frac{95 - 84}{5} = \frac{11}{5}$

Image = $\left(\frac{11}{5}, \frac{28}{5}\right)$

Q.20 Consider the statement : "For an integer n, if n^3-1 is even, then n is odd." The contrapositive statement of this statement is:
(1) For an integer n, if n is even, then n^3-1 is even
(2) For an integer n, if n is odd, then n^3-1 is even
(3) For an integer n, if n^3-1 is not even, then n is not odd.
(4) For an integer n, if n is even, then n^3-1 is odd
कथन पर विचार कीजिए : " एक पूर्णांक n के लिए, यदि n^3-1 सम है तो n विषम है। " इस कथन का प्रतिध्नात्मक (contrapositive) कथन है :
(1) एक पूर्णांक n के लिए, यदि n सम है, तो n^3-1 सम है
(2) एक पूर्णांक n के लिए, यदि n विषम है, तो n^3-1 सम है
(3) एक पूर्णांक n के लिए, यदि n^3-1 सम नहीं है तो n विषम नहीं है।
(4) एक पूर्णांक n के लिए, यदि n सम है, तो n^3-1 विषम है।

Sol. **(4)**
P:n^3-1 is even, q : n is odd
Contrapositive of $p \to q = \sim q \to \sim p$
$\Rightarrow$ If n is not odd then n^3-1 is not even
$\Rightarrow$ For an integer n, if n is even, then n^3-1 is odd

Q.21 The number of words (with or without meaning) that can be formed from all the letters of the word "LETTER" in which vowels never come together is_____
"LETTER" शब्द के सभी अक्षरों से बन सकने वाले ऐसे शब्दों (अर्थ वाले अथवा अर्थहीन) जिनमें स्वर कभी भी एक साथ नहीं आते, की संख्या है–

Sol. **120**
Consonants $\to$ LTTR
Vowels $\to$ EE

Total No of words = $\frac{6!}{2!2!} = 180$

Total no of words if vowels are together

$= \frac{5!}{2!} = 60$

Required = 180 – 60 = 120

Q.22 If $\vec{x}$ and $\vec{y}$ be two non-zero vectors such that $|\vec{x}+\vec{y}| = |\vec{x}|$ and $2\vec{x}+\lambda\vec{y}$ is perpendicular to $\vec{y}$, then the value of λ is _____
यदि $\vec{x}$ तथा $\vec{y}$ दो शून्येत्तर सदिश इस प्रकार हैं कि $|\vec{x}+\vec{y}| = |\vec{x}|$ और $2\vec{x}+\lambda\vec{y}$, सदिश $\vec{y}$ के लम्बवत है, तो λ का मान है _____।

Sol. **1**

$|\bar{x}+\bar{y}|^2 = |\bar{x}|^2$

$\Rightarrow |\bar{y}|^2 + 2\bar{x}.\bar{y} = 0$ _____(1)

and $(2\bar{x}+\lambda\bar{y})\bar{y} = 0$

$\Rightarrow \lambda\left(|\bar{y}|^2\right) + 2\bar{x}.\bar{y} = 0$ _____(2)

by comparing (1) & (2)
we get $\lambda = 1$

Q.23 Consider the data on x taking the values 0, 2, 4, 8, ...,2^n with frequencies ${}^nC_0, {}^nC_1, {}^nC_2, \ldots {}^nC_n$, respectively. If the mean of this data is $\frac{728}{2^n}$, then n is equal to _____

आंकड़े जिनमें x के मानों 0, 2, 4, 8, ...,2^n की बारंबारता क्रमशः ${}^nC_0, {}^nC_1, {}^nC_2, \ldots {}^nC_n$ हैं, पर विचार कीजिए। यदि इन आंकड़ों का माध्य $\frac{728}{2^n}$ हैं, तो n बराबर है _____।

Sol. **6**

X_i(observation)	0	2	2^2	.....	2^n
f_i (frequency)	${}^nC_0$	${}^nC_1$	${}^nC_2$	.....	${}^nC_n$

$$\bar{x} = \frac{\sum f_i X_i}{\sum f_i}$$

$$= \frac{0\times {}^nC_0 + 2\,{}^nc_1 + 2^2\,{}^nc_2 + \ldots\ldots + 2^n\,{}^nc_n}{{}^nc_0 + {}^nc_1 + \ldots\ldots + {}^nc_n}$$

$$= \frac{3^n - 1}{2^n} = \frac{728}{2^n}$$

$3^n = 729 = 3^6$
$n = 6$

Q.24 Suppose that function $f : R \to R$ satisfies f(x+y)=f(x)f(y) for all x, $y \in R$ and f(1)=3.

If $\sum_{i=1}^{n} f(i) = 363$, then n is equal to .....

माना कि एक फलन $f : R \to R$, सभी x, $y \in R$ के लिए f(x+y)=f(x)f(y) को संतुष्ट करता है तथा f(1)=3 है। यदि $\sum_{i=1}^{n} f(i) = 363$ है, तो n बराबर है

Sol. **5**

f(x+y) = f(x) f(y)
$f(x)=a^x$
$\Rightarrow f(1) = a = 3$
So $f(x) = 3^x$

$$\sum_{i=1}^{n} f(i) = 363$$

$\Rightarrow 3 + 3^2 + 3^3 + \ldots + 3^n = 363$

$$\Rightarrow \frac{3\left(3^n-1\right)}{2} = 363$$

n = 5

Q.25 The sum of distinct values of λ for which the system of equations

$(\lambda-1)x+(3\lambda+1)y+2\lambda z=0$

$(\lambda-1)x+(4\lambda-2)y+(\lambda+3)z=0$

$2x+(3\lambda+1)y+3(\lambda-1)z=0$,

has non-zero solutions,is _____

λ के उन भिन्न मानों का योग, जिनके लिए समीकरण निकाय

$(\lambda-1)x+(3\lambda+1)y+2\lambda z=0$

$(\lambda-1)x+(4\lambda-2)y+(\lambda+3)z=0$

$2x+(3\lambda+1)y+3(\lambda-1)z=0$,

के शून्येतर (non-zero) हल हैं, है _____।

Sol. **3**

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

$R_2 \to R_2 - R_1$
$R_3 \to R_3 - R_1$

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

$C_1 \to C_1 + C_3$

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

$(\lambda-3)[(3\lambda-1)(\lambda-3)-(3-\lambda)(3\lambda+1)] = 0$
$(\lambda-3)[3\lambda^2-10\lambda+3-(8\lambda-3\lambda^2+3)] = 0$
$(\lambda-3)(6\lambda^2-18\lambda) = 0$
$(6\lambda)(\lambda-3)^2 = 0$
$\lambda = 0, 3$
sum of values of $\lambda = 0 + 3 = 3$

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