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42 (A)

$$I = \int_{-\pi/2}^{\pi/2} \frac{x^2 \cos x\,dx}{1+e^x} \quad \text{—(1)}$$

$$I = \int_{-\pi/2}^{\pi/2} \frac{(-x)^2 \cos(-x)\,dx}{1+e^{-x}} \rightarrow \int_{-\pi/2}^{\pi/2} \frac{x^2 \cos x\, e^x}{e^x+1} \quad \text{—(2)}$$

adding (1) & (2)

$$2I = \int_{-\pi/2}^{\pi/2} \frac{x^2 \cos x\,(e^x+1)\,dx}{(e^x+1)}$$

$$2I = \int_{-\pi/2}^{\pi/2} x^2 \cos x \rightarrow 2I = 2\int_0^{\pi/2} x^2 \cos x\,dx$$

$$I = \int_0^{\pi/2} x^2 \cos x\,dx.$$

$$I = \left(\sin x\, x^2\right)_0^{\pi/2} - \int_0^{\pi/2} \sin x\, 2x\,dx.$$

$$= \frac{\pi^2}{4} - \left[\left(-\cos x\,(2x)\right)_0^{\pi/2} - \int_0^{\pi/2} -\cos x\,(2)\right].$$

$$= \frac{\pi^2}{4} - 2 \text{ so option (A).}$$

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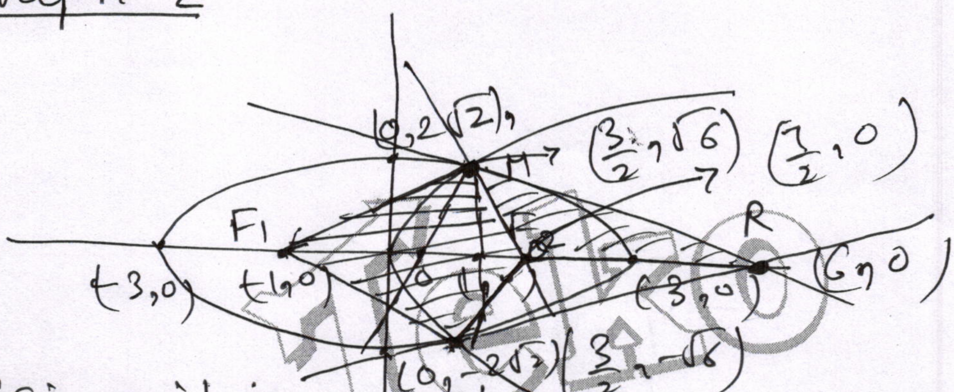
Paragraph-2

Q.53
(A)



Since it is Isocelus triangle.

→ Orthocentre (O) will lie on x axis → y = 0

eqn of line ⊥ F1N & passing through M.

$m_{FN} = -\frac{\sqrt{6}}{3} \times 2 = -\frac{2\sqrt{6}}{3}$

$m_1 m_2 = -1$ $\quad m_{OM} = \frac{3}{2\sqrt{6}}$

so eqn of OM

$= (y - \sqrt{6}) = \frac{3}{2\sqrt{6}}\left(x - \frac{3}{2}\right)$

& $y = 0$

so $x = -\frac{9}{10}$, Ans (A)

Q.54
(C)

$R \to (6, 0)$

area of MNF_1F_2 = ar(MNF_1) − ar(MF_2N)

$= \frac{1}{2} \times 2\sqrt{6} \times \left(\frac{3}{2} + 1\right) - \frac{1}{2} \times 2\sqrt{6}\left(\frac{3}{2} - 1\right)$

$= \sqrt{6}(2) = 2\sqrt{6}$

area(ΔMQR)

$= \frac{1}{2}\begin{vmatrix} \frac{3}{2} & \sqrt{6} & 1 \\ 6 & 0 & 1 \\ \frac{7}{2} & 0 & 1 \end{vmatrix}$

For (Q) eqn:
$y = mx - 2am - am^3$
eqn of MQ $a = 1$, $m = -\frac{y}{2} = -\frac{\sqrt{6}}{2}$
$y - \sqrt{6} = -\frac{\sqrt{6}}{2}\left(x - \frac{3}{2}\right)$
Put $y = 0$ $\quad x = \frac{7}{2}$

ratio $= \frac{2\sqrt{6} \times 4}{5\sqrt{6}} = \frac{5}{8} = 5\sqrt{6}/4$

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51 Paragraph – I.

(B) For $P(X>Y)$

T_1	T_2	T_1	T_2	T_1	T_2
W	L	W	L	D	D
W	L	D	D	W	L

$$\frac{1}{2}\times\frac{1}{2}+\frac{1}{2}\times\frac{1}{6}+\frac{1}{6}\times\frac{1}{2}$$

$$=\frac{1}{4}+\frac{1}{12}+\frac{1}{12}$$

$$=\frac{1}{4}+\frac{1}{6}\rightarrow\frac{5}{12}.\ (B)$$

52 For $P(X=Y)$

(C)

T_1	T_2	T_1	T_2	T_1	T_2
W	L	L	W	D	D
L	W	W	L	D	D

$$\frac{1}{2}\times\frac{1}{3}+\frac{1}{2}\times\frac{1}{3}+\frac{1}{6}\times\frac{1}{6}$$

$$=\frac{1}{6}+\frac{1}{6}+\frac{1}{36}$$

$$=\frac{6+6+1}{36}=\frac{13}{36}\ (C)$$

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Q49. (B, C, D) Let $a, \lambda, \mu \in R$. Consider ......

$ax + 2y = \lambda$ for infinite sol^{n}s $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

$3x - 2y = \mu$ $\quad \frac{a}{3} = \frac{2}{-2} = \frac{\lambda}{\mu}$ $\quad a = -3$ $\lambda = -\mu$

so $\lambda + \mu = 0$ $a = -3$ for infinite sol^{n}s

for no sol^n:- $\frac{a}{3} = \frac{2}{-2} \neq \frac{\lambda}{\mu}$ $\quad \lambda + \mu \neq 0$ $a = -3$ no solution.

for unique sol^n $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$ $\quad \frac{a}{3} \neq \frac{2}{-2}$ $\quad a \neq -3$

49 BCD

Q44. (A, C, D) $x + iy = \frac{a - ibt}{a^2 + b^2t^2}$

(C) option $b = 0$ $a \neq 0$ $\quad y = 0$ x axis

$x + iy = \frac{a}{a^2} = \frac{1}{a}$ $\quad x = 1/a$

(d) option $a = 0$ $\quad x + iy = \frac{-ibt}{b^2t^2} = \frac{-i}{bt}$ $\quad y = \frac{-1}{bt}$ y axis

$x + iy = \frac{a}{a^2 + b^2t^2} \; \frac{-ibt}{a^2 + b^2t^2}$

$x = \frac{a}{a^2 + b^2t^2}$ ① $\quad y = \frac{-bt}{a^2 + b^2t^2}$ ② $\quad$ ① ÷ ② $\quad \frac{x}{y} = \frac{-a}{bt}$ $\quad t = \frac{-ay}{bx}$

Put in ①

$x = \frac{a}{a^2 + b^2 \frac{a^2y^2}{b^2x^2}}$ $\quad x = \frac{a x^2}{a^2(x^2 + y^2)}$ $\quad x^2 + y^2 - \frac{x}{a} = 0$

$x^2 + y^2 = \frac{x}{a}$ $\quad C\left(\frac{1}{2a}, 0\right)$

$r = \frac{1}{2a}$ $\quad$ for $a > 0$ $|a| = a$ $\quad r = \sqrt{\frac{1}{4a^2}} = \frac{1}{2|a|}$

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40 (C) $\frac{x-3}{1} = \frac{y-1}{-2} = \frac{z-7}{1} = K$

$x = K+3$

$y = -K+1$

$z = K+7$.

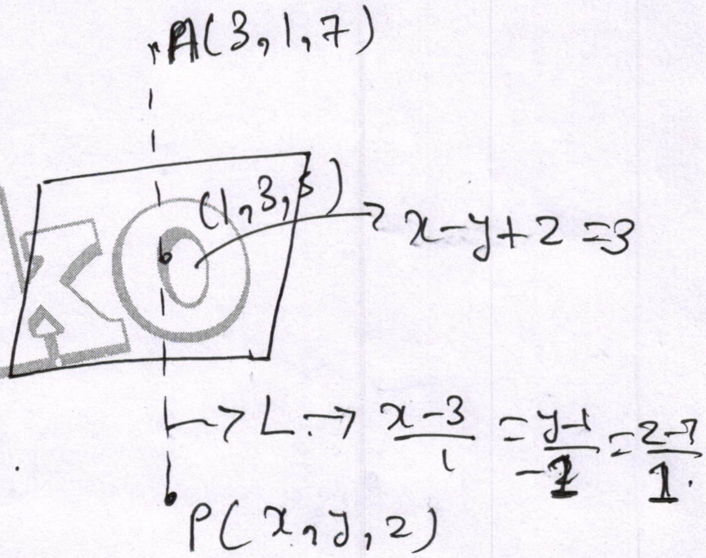
it will satisfy plane

$(K+3) - (-K+1) + K+7 = 3$

$3K = -6 \Rightarrow K = -2$

$x = 1 \quad y = 3, \; z = 5$.

So $P(-1, 5, 3)$



P will lie on plane & also $\frac{x}{1} = \frac{y}{2} = \frac{z}{1}$ is in plane so dot product of d.c's should be o.

checking option c

$-1 - 4(5) + 7(3) = 0$

& $1 - 4.2 + 7.1 = 0$

Hence (c) is correct.

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Q.39 Let $b_i > 1$ for $i = 1, 2 \ldots 101$. then.

(B) $\log_e b_1, \log_e b_2 \ldots \log_e b_{101} \rightarrow$ A.P. c.d $= \log_e 2$

$\Rightarrow b_1, b_2, b_3 \ldots b_{101} \rightarrow$ G.P. $\boxed{r = 2}$

so $b_{51} = 2^{50} b_1$.

$a_1, a_2 \ldots a_{101} \rightarrow$ A.P.

$a_1 = b_1$ & $a_{51} = b_{51}$.

so $a_1 + 50d = 2^{50} b_1$.

now $a_{101} = a_1 + 100d$. $\quad d = \frac{(2^{50}-1)b_1}{50}$

$= b_1 + 100(2^{50}-1)b_1$

$= b_1[2^{51}-1]$. but $b_{101} = 2^{100} b_1$

so $b_{101} > a_{101}$.

now $t = b_1 + b_2 \ldots b_{50}$

$= \frac{b_1(2^{50}-1)}{2-1} = (2^{50}-1)b_1$

$s = \frac{51}{2}[a_1 + a_{51}] = \frac{51}{2}[b_1 + b_1(2^{51}-1)]$.

$= \frac{51}{2}(2^{51})b_1$.

so $s > t$

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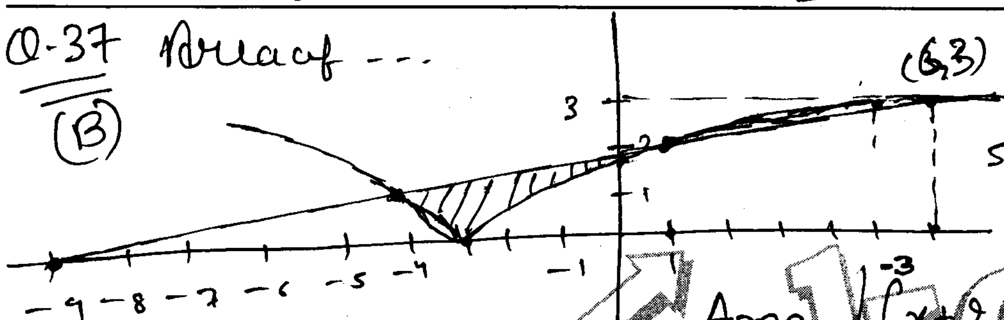
Q-37 Area of ---

(B)

$5y \le x + 9 \le 15$

$5y - 9 \le x \le 6$



$$\text{Area} = \left|\int_{-4}^{-3}\left(\frac{x+9}{5} - \sqrt{-x-3}\right)\right| + \int_{-3}^{1}\left(\frac{x+9}{5} - \sqrt{x+3}\right) + \int_{1}^{6}\left(\sqrt{x+3} - \frac{x+9}{5}\right)dx$$

Solve it self (Just integrate)

$$\text{Area} = \frac{13}{30} + \frac{32}{30} + \frac{5}{30} = \frac{40}{30} = \frac{4}{3}$$

The value of ---------

Q38. Using $\sin(A-B) = \sin A \sin B(\cot B - \cot A)$

$A = \frac{\pi}{4} + \frac{k\pi}{6} \quad B = \frac{\pi}{4} + \frac{(k-1)\pi}{6}$

$$\frac{1}{\sin A \sin B} = \frac{\cot B - \cot A}{\sin(A-B)}$$

$A - B = \frac{\pi}{6}$

(C)

$k=1 \quad = -2\left[\cot\left(\pi/4 + \pi/6\right) - \cot \pi/4\right]$

$k=2 \quad -2\left[\cot\left(\frac{\pi}{4} + 2\pi/6\right) - \cot\left(\pi/4 + \pi/6\right)\right]$

$\quad -2\left[\cot\left(\pi/4 + 13\pi/6\right) - \cot\left(\pi/4 + 12\pi/6\right)\right]$

$k=13 \quad -2\left[\cot\left(\pi/4 + 13\pi/6\right) - \cot \pi/4\right]$

$= -2\left[\cot\left(\pi/4 + 13\pi/6\right) - 1\right]$

$= -2\left[\cot\left(\pi/4 + \pi/6\right) - 1\right]$

$= -2\left[\cot 75^\circ - 1\right] = -2\left[2 - \sqrt{3} - 1\right]$

$= 2\left[\sqrt{3} - 1\right]$ (C)

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Q.47. Let $a, b \in R$, $f: R \to R$ be defined by $f(x) = a\cos$...

Sol. (ABD)

for A ✓ $f(x) = |x| \cdot \sin(|x^3 + x|)$ at $x = 0$
LHD = RHD = 0

for B ✓ $f(x) = \cos(|x^3 - x|)$ at $x = 1$
LHD = RHD = 0

for C ✗ $f(x) = \cos(|x^3 - x|)$ at $x = 0$
LHD = RHD = 0
is diff.ble.

for D ✓ $f(x) = \cos|x^3 - x| + |x| \cdot \sin|x^3 + x|$
LHD ≠ RHD

Q.48. Let $\hat{u} = u_1\hat{i} + u_2\hat{j} + u_3\hat{k}$ be a unit vector, ---

Sol. (BC)

A is wrong

B is correct → because $\hat{w} \cdot (\hat{u} \times \vec{v}) = 1$

$|\hat{w}| \cdot |\hat{u} \times \vec{v}| \cos\theta = 1$

$1 \times 1 \times \cos\theta = 1$

$\theta = 0$

So $\hat{w}$ & $(\hat{u} \times \vec{v})$ are parallel

So $\hat{w} = \hat{u} \times \vec{v}$

Same vector

$\vec{v}$ अपनी length and $\hat{u}$ के साथ angle बदल बदल कर कई Position gain कर सकता है

C is correct

$\hat{u} \times \vec{v} = \hat{w}$

So $\hat{u}$ & $\hat{w}$ are ⊥

dot product zero

$u_1 \cdot 1 + u_2 \cdot 1 = 0$

$u_1 = -u_2$

$|u_1| = |u_2|$

D is wrong

$u_1 \cdot 1 + 2 \cdot u_3 = 0$

$u_1 = -2u_3$

$|u_1| = 2|u_3|$

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Q.45 (A, D)

$$\lim_{x\to 2} \frac{f(x).g(x)}{f'(x).g'(x)} = 1$$

0/0 case

using L. Hospital

$$\lim_{x\to 2} \frac{f'(x).g(x) + f(x)g'(x)}{f''(x)g'(x) + f'(x)g''(x)} = 1$$

$$= \lim_{x\to 2} \frac{f(x)\,g'(x)}{f''(x)\,g'(x)} = \lim_{x\to 2} \frac{f(x)}{f''(x)} = 1$$

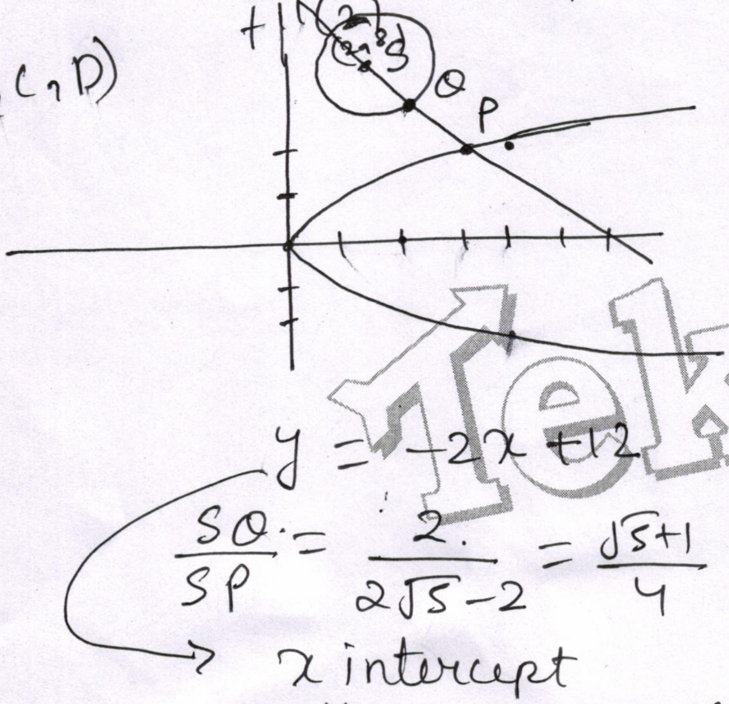
since $f(x) = +ve$

so $f''(2) = +ve$ hence

it has minima at $x = 2$. (A)

& $\frac{f(2)}{f''(2)} = 1$ $f(2) - f''(2) = 0$ (D)

46 (A, C, D)



→ Shortest distance is along common normal.

normal of parabola

so normal

$y = mx - am^3 - 2m$.

it passes (2, 8)

which gives $m = -2$

↓

$P(4, 4)$

$y = -2x + 12$

$$\frac{SQ}{SP} = \frac{2}{2\sqrt{5} - 2} = \frac{\sqrt{5}+1}{4}$$

$\rightarrow SP = \sqrt{(4-2)^2 + (8-4)^2}$

$= 2\sqrt{5}$.

→ x intercept

$y = 0 \longrightarrow x = 6$.

slope of circle at Q.

→ $x^2 + y^2 - 4x - 16y + 64 = 0$

diff $2x + 2yy' - 4 - 16y' + 0 = 0$.

$y' = \frac{2-x}{y-8}$

$2 - x = \frac{-4}{2\sqrt{5}}$ $y' = \frac{1}{2}$

$y - 8 = -8/2\sqrt{5}$

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Q.41. (B) Let $P = \begin{bmatrix} 1 & 0 & 0 \\ 4 & 1 & 0 \\ 16 & 4 & 1 \end{bmatrix}$ and I ...

Sol. $P^2 = \begin{bmatrix} 1 & 0 & 0 \\ 8 & 1 & 0 \\ 16\times 3 & 8 & 1 \end{bmatrix}$; $P^3 = \begin{bmatrix} 1 & 0 & 0 \\ 12 & 1 & 0 \\ 16\times 6 & 12 & 1 \end{bmatrix}$

($8 = 4\times 2$, $3 = (1+2)$; $12 = 4\times 3$, $6 = (1+2+3)$)

$$P^{50} = \begin{bmatrix} 1 & 0 & 0 \\ 4\times 50 & 1 & 0 \\ 16(1+2+\dots+50) & 4\times 50 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 200 & 1 & 0 \\ 20400 & 200 & 1 \end{bmatrix}$$

Given $P^{50} - Q = I \longrightarrow Q = \begin{bmatrix} 0 & 0 & 0 \\ 200 & 0 & 0 \\ 20400 & 200 & 0 \end{bmatrix}$ ($q_{21} = 200$, $q_{31} = 20400$, $q_{32} = 200$)

finding

$$\frac{q_{31}+q_{32}}{q_{21}} = \frac{20400+200}{200} = 103 \text{ (B)}$$

50) (B, D) Let $f : \left[-\frac{1}{2}, 2\right] \longrightarrow R$. ... $J \in R$ Then.

$f(x) = [x^2 - 3]$

Since G.I.F is discontinuous at integers

$-3 \le x^2 - 3 \le 1$

so $-3, -2, -1, 0, 1$ may be 5 points of discontinuity → But cont^n at $x=0$

& $g(x) = |x| f(x) + |4x-7| f(x)$.

$= f(x)\left[|x| + |4x-7|\right]$

$f(x)$ ↓ discontinuous $1, \sqrt{2}, \sqrt{3}, 2$; ↓ $0, \frac{7}{4}$

end points are not consider in differentiability.

SOLUTIONS OF JEE ADVANCED 2016 PAPER 2 CODE 4 SAME DAY WITH IN 2 HOURS

Q.43. (BC)

Let $f(x)=\lim_{n\to\infty}\left(\frac{n^n(x+n)(x+\frac{n}{2})\cdots\cdots(x+\frac{n}{n})}{\lfloor n\,(x^2+n^2)(x^2+\frac{n^2}{4})\cdots\cdots(x^2+\frac{n^2}{n^2})}\right)^{\frac{x}{n}}$

Sol.

$$f(x)=\lim_{n\to\infty}\left\{\frac{n^n\cdot n^n(\frac{x}{n}+1)(\frac{x}{n}+\frac{1}{2})\cdots\cdots(\frac{x}{n}+\frac{1}{n})}{\lfloor n\,(n^n)^2(\frac{x^2}{n^2}+1)(\frac{x^2}{n^2}+\frac{1}{2^2})+\cdots(\frac{x^2}{n^2}+\frac{1}{n^2})}\right\}^{\frac{x}{n}}$$

$$\ln f(x)=\lim_{n\to\infty}\frac{x}{n}\left\{\sum_{r=1}^{n}\ln\left(\frac{x}{n}+\frac{1}{r}\right)-\sum_{r=1}^{n}\ln\left(\frac{rx^2}{n^2}+\frac{1}{r}\right)\right\}$$

taking $\frac{1}{r}$ common out from both & cancelled out

$$\ln f(x)=\lim_{n\to\infty}\frac{x}{n}\left\{\sum_{r=1}^{n}\ln\left(1+\frac{rx}{n}\right)-\sum_{r=1}^{n}\ln\left(1+\frac{r^2x^2}{n^2}\right)\right\}$$

lim convert to integrati

$$\ln f(x)=x\int_0^1\ln(1+xy)\,dy-x\int_0^1\ln(1+x^2y^2)\,dy$$

Let $xy=t$

$$\ln f(x)=\int_0^x\ln(1+t)\,dt-\int_0^x\ln(1+t^2)\,dt$$

$$\frac{f'(x)}{f(x)}=\ln\left(\frac{1+x}{1+x^2}\right)$$

$\frac{f'(2)}{f(2)}=\ln\left(\frac{3}{5}\right)<0;\ f'(2)<0$

$\frac{f'(3)}{f(3)}=\ln\left(\frac{4}{10}\right)<0$ (B) ✓

See Next Page अगला Page देखे

P.T.O.

Part que 43 from Page 11 ; $f(x) = +ve$

$\frac{f'(x)}{f(x)} > 0$ in $0 < x < 1$ & $\frac{f'(x)}{f(x)} < 0$ in $1 < x$

$f(x) \uparrow$ & $f(x) \downarrow$

$f(1) \geq f(\frac{1}{2})$ & $f(\frac{1}{3}) \leq f(\frac{2}{3})$.

becoz $1 \geq \frac{1}{2}$ | becoz $\frac{1}{3} < \frac{2}{3}$

$\uparrow$ fun. मे sign change नहीं होता | $\downarrow$ func मे sign change होता है