JEE Main Set D Page-1

(1) If curve $y^2 = 6x$ ..... ?

(A) $y^2 = 6x$ Tangent to $y \cdot y_1 = 3(x + x_1)$

Tangent to $9x^2 + by^2 = 16$

$9xx_1 + byy_1 = 16$

$byy_1 = -9xx_1 + 16$

$y = -\frac{9x_1}{by_1}x + \sim$

Slope $\frac{3}{y_1}$

Slope $= -\frac{9}{b}\frac{x_1}{y_1}$

$\frac{3}{y_1} \times -\frac{9}{b} \times \frac{x_1}{y_1} = -1$ (curve are orthogonal)

$\pm 27\frac{x_1}{y_1^2} = \pm 1 \Rightarrow 27 \times \frac{1}{6} = \frac{9}{2}$

$y_1^2 = 6x_1 \Rightarrow \frac{1}{6} = \frac{x_1}{y_1^2}$

(2) let $\vec{u}$ coplanar ..... ?

Ans

PTO

(2) (B) Let $\vec{u} = a\hat{i} + b\hat{j} + c\hat{k}$

$\vec{a} \times \vec{b} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 2 & -1 \\ 0 & 1 & 1 \end{vmatrix} \Rightarrow \hat{i}(3+1) - \hat{j}(2) + \hat{k}2$

$\vec{u}$ coplanar with $\vec{a}$ & $\vec{b}$

$\therefore \vec{u} \cdot (\vec{a} \times \vec{b}) = 0$

$(a\hat{i} + b\hat{j} + c\hat{k}) \cdot (4\hat{i} - 2\hat{j} + 2\hat{k}) = 0$

$4a - 2b + 2c = 0 \quad \ldots (i)$

$\vec{a} \perp \vec{u}$

$\therefore \vec{a} \cdot \vec{u} = 0$

$(a\hat{i} + b\hat{j} + c\hat{k}) \cdot (2\hat{i} + 3\hat{j} - \hat{k}) = 0$

$2a + 3b - c = 0 \quad -(ii)$

$\vec{u} \cdot \vec{b} = 24$

$(a\hat{i} + b\hat{j} + c\hat{k}) \cdot (0\hat{i} + \hat{j} + \hat{k}) = 24$

$b + c = 24 \Rightarrow 3b = 24 \Rightarrow b = 8$

$(ii) \times 2 - i \Rightarrow 4a + 6b - 2c - 4a + 2b - 2c = 0$

$8b - 4c = 0$

$2b = c \quad \ldots (iii)$

$b + c = 24$

$8 + c = 24$

$c = 16$

$2a + 3(8) - 16 = 0$

$2a + 24 - 16 = 0$

$2a = -8$

$a = -4$

$|\vec{u}| = \sqrt{a^2 + b^2 + c^2}$

$\sqrt{(4)^2 + (8)^2 + (16)^2}$

$\sqrt{16 + 64 + 256}$

$|\vec{u}| = \sqrt{336}$

$|\vec{u}|^2 = 336$ Ans

11
256
64
16
336

... Page 4

(5) (A) The value of $\int_{-\pi/2}^{\pi/2} \frac{\sin^2 x}{1+2^x}\,dx$

$$I = \int_{-\pi/2}^{\pi/2} \frac{\sin^2 x}{1+2^x}$$

property $\int f(x) = \int f(a+b-x)$

$$I = \int_{-\pi/2}^{\pi/2} \frac{\sin^2\left(\frac{\pi}{2}-\frac{\pi}{2}-x\right)}{1+2^{\frac{\pi}{2}-\frac{\pi}{2}-x}}$$

$$I = \int_{-\pi/2}^{\pi/2} \frac{\sin^2 x}{1+2^{-x}}$$

$$I = \int_{-\pi/2}^{\pi/2} \frac{2^x \sin^2 x}{2^x+1}$$

(+) $$2I = \int_{-\pi/2}^{\pi/2} \sin^2 x \left(\frac{2^x+1}{2^x+1}\right)$$

$$2I = \int_{-\pi/2}^{\pi/2} \sin^2 x\,dx$$

$$2I = 2\int_{0}^{\pi/2} \sin^2 x\,dx$$

$$2I = 2 \times \frac{\pi}{4}$$

$$I = \pi/4$$ Ans

PTO

(6) $g(x) = \cos x^2 \quad f(x) = \sqrt{x}$

(B) $18x^2 - 9\pi x + \pi^2 = 0$

$18x^2 - 6\pi x - 3\pi x + \pi^2 = 0$

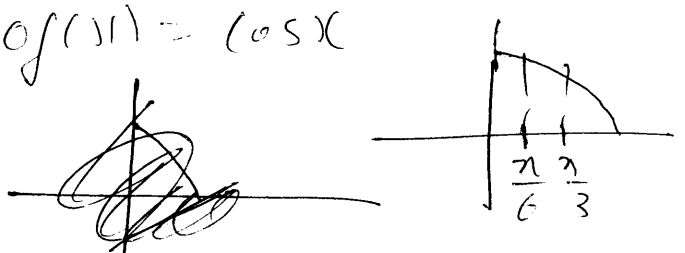
$6x(3x - \pi) - \pi(3x - \pi) = 0$

$(3x - \pi)(6x - \pi) = 0$

$x = \frac{\pi}{3} \quad x = \frac{\pi}{6}$

$\alpha = \frac{\pi}{6} \quad \beta = \frac{\pi}{3}$

$gof(x) = \cos x$



$\int_{\pi/6}^{\pi/3} \cos x\,dx = [\sin x]_{\pi/6}^{\pi/3}$

$\frac{\sqrt{3}}{2} - \frac{1}{2} = \frac{1}{2}(\sqrt{3} - 1)$ Ans

(7) If sum of all solutions of $8\cos x(\cos(\cos x) - ?$

(C) $8\cos x\left(\cos\left(\frac{\pi}{6} + x\right)\cos\left(\frac{\pi}{6} - x\right) - \frac{1}{2}\right) = 1$

$4\cos x\left(2\cos\left(\frac{\pi}{6} + x\right)\cos\left(\frac{\pi}{6} - x\right) - 1\right) = 1$ PTO

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$\cos x\left[4\left(\cos\frac{\pi}{3}+\cos 2x\right)-1\right]=1$

$\cos x\left(4\left(\frac{1}{2}+\cos 2x\right)-1\right)=1$

$\cos x\left(4\cos 2x-1\right)=1$

$4\cos x\cos 2x-2\cos x=1$

$4\cos x\cos 2x=1+2\cos x$

$2\left[2\cos x\cos 2x\right]=1+2\cos x$

$2\left(\cos x+\cos 3x\right)=1+2\cos x$

$2\cos 3x=1$

$\cos 3x=1/2$

$0<x<\pi$

$0<3x<3\pi$

$3x\to\frac{\pi}{3},\ 2\pi-\frac{\pi}{3},\ 2\pi+\frac{\pi}{3}$

$3x\to\frac{\pi}{3},\ \frac{5\pi}{3},\ \frac{7\pi}{3}$

$x\to\frac{\pi}{9},\ \frac{5\pi}{9},\ \frac{7\pi}{9}$

Sum $\frac{13\pi}{9}$ $\therefore k=\frac{13}{9}$ Ans

PTO

(10) A bag contains 4 Red, 6 Black ball. - ? 12|81

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Total Probability :-

First draw give Red $\frac{4}{10}$

→ Second draw give Red $\frac{6}{12} \times \frac{4}{10}$

→ Second draw give Black $\frac{6}{12} \times \frac{4}{10}$

First draw give Black $\frac{6}{10}$

→ Second draw give Red $\frac{4}{12} \times \frac{6}{10}$

→ Second draw give Black $\frac{8}{12} \times \frac{6}{10}$

Total probability $= \frac{6}{12} \times \frac{4}{10} + \frac{6}{12} \times \frac{4}{10} + \frac{4}{12} \times \frac{6}{10} + \frac{8}{12} \times \frac{6}{10}$

Favourable cases → $\frac{6}{12} \times \frac{4}{10} + \frac{4}{12} \times \frac{6}{10}$

Ans $= \frac{6\times4 + 4\times6}{6\times4 + 6\times4 + 6\times4 + 8\times6}$

72
48
120

$= \frac{48}{120} = \frac{4}{10}$

$= \frac{2}{5}$ Ans

PTO

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(11) Let the orthocentre and (e)ntroid ... ?

(4) A(-3,5) ← 2 → B(3,3) ← 1 → C(h,k)

Centroid divides AC in ratio 2:1

$\therefore \frac{2h-3}{3} = 3 \Rightarrow 2h-3 = 9$

$h = 6$

$\frac{2k+5}{3} = 3 \Rightarrow 2k+5 = 9$

$2k = 4$

$k = 2$

Circumcentre C(6,2)

$\therefore$ Diameter $AC = \sqrt{(6-(-3))^2+(2-5)^2}$

$= \sqrt{90}$

Radius $= \frac{\sqrt{90}}{2} = \frac{3\sqrt{10}}{2} = \boxed{3\sqrt{\frac{5}{2}}}$ Ans

(12) If tangent at (1,7) ... PTO ?

$y^2 = y - 6$

$2x = \frac{dy}{dx} \Rightarrow m_T = 2$

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Eqn of ~~St D~~ Page 10

Eqn of Tangent

$y-7=2(x-1)$

$y-7=2x-2$

$y-2x-5=0$

Tangent to circle $x^2+y^2+16x+12y+c=0$

& centre $(-8,-6)$

~~radius $=\sqrt{100-c}$~~

radius $=\sqrt{100-c}$

$\therefore \left|\frac{-6-2(-8)-5}{\sqrt{5}}\right| = \sqrt{100-c}$

$\left|\frac{-6+16-5}{\sqrt{5}}\right| = \sqrt{100-c}$

$\left|\frac{16-11}{\sqrt{5}}\right| = \sqrt{100-c}$

$\left|\frac{5}{\sqrt{5}}\right| = \sqrt{100-c}$

$5 = 100-c$

$\boxed{c=95}$ Ans

PTO

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(13) If $\alpha, \beta \in C$ ... $x^2 - x + 1 = 0$ ....

(D)

$x^2 - x + 1 = 0$

$-\omega \to \alpha$

roots $\frac{1 \pm \sqrt{3}\, i}{2} \Leftrightarrow -\omega^2 \to \beta$

$(-\omega)^{101} + (-\omega^2)^{107}$

$-(\omega^{101} + (\omega^2)^{107})$

$-(\omega^{99}\cdot\omega^2 + (\omega^{105})^2 \times (\omega^2)^2)$

$-(\omega^2 + \omega^4)$

$-(\omega^2 + \omega)$

$1 + \omega + \omega^2 = 0$

$\omega + \omega^2 = -1$

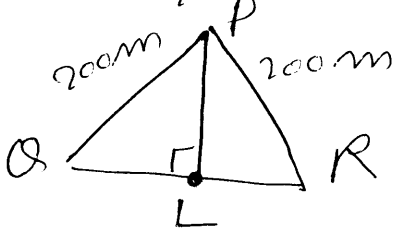
$\Rightarrow$ Ans 1

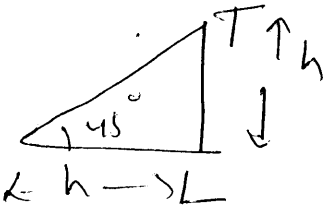
(14) PQR is triangular park ... ?

(B)

PTO

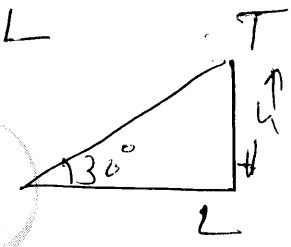
Q Code 21 Set - D





$P \perp h \to L$

$PL = h$



In $\triangle PLQ$

$PL^2 + QL^2 = PQ^2$

$h^2 + 3h^2 = (200)^2$

$4h^2 = (200)^2$

$h^2 = \left(\frac{200}{2}\right)^2$

$h^2 = (100)^2$

$\boxed{h = 100 \text{ Ans}}$

$\tan 30° = \frac{h}{QL}$

$\frac{1}{\sqrt{3}} = \frac{h}{QL}$

$QL = \sqrt{3}h$

(16) If sum of coeffn ---- $(x+\sqrt{x^3-1})^5$ ---- ?

(A) $(x+\sqrt{x^3-1})^5 + (x-\sqrt{x^3-1})^5$

$(x+\sqrt{x^3-1})^5 = {}^5C_0 x^5 + {}^5C_1 \sqrt{x^3-1}\, x^4 + {}^5C_2 (\sqrt{x^3-1})^2 x^3 + \cdots$

$(x-\sqrt{x^3-1})^5 = {}^5C_0 x^5 - {}^5C_1 (\sqrt{x^3-1})\, x^4 + {}^5C_2 (\sqrt{x^3-1})^2 x^3 - \cdots$

PTO

Q) 121+1 Sctn

$= 2\left[{}^5C_0 x^5 + {}^5C_2 x^3 (x^3-1) + {}^5C_4 ((x^3-1)^2 \right]$

$= 2\left[{}^5C_0 x^5 + {}^5C_2 x^6 - {}^5C_2 x^3 + {}^5C_4 (x^6+1-2x^3) \right]$

$= 2\left[{}^5C_0 x^5 + {}^5C_2 x^6 - {}^5C_2 x^3 + {}^5C_4 x^7 + {}^5C_4 - 2\,{}^5C_4 \right]$

sum of odd coeff^n

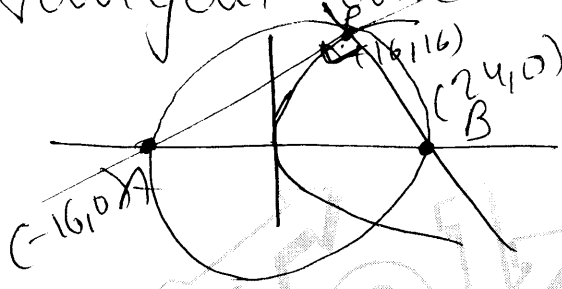
$2\left[{}^5C_0 - {}^5C_2 + 2\,{}^5C_4 \right]$

$2\left[1 - 10 + 2 \times 5 \right]$

$2(1) = 2$ Ans

22 C

Tangent and Normal $y^2 = 16x$?



$2y\frac{dy}{dx} = 16$

$\frac{dy}{dx} = \frac{8}{y}$

$m_T = \frac{8}{16} = \frac{1}{2}$

$m_N = -2$

8th April 2018 Set-D

Tang: $y-16=\frac{1}{2}(x-16)$ Normal $(y-16)=-2(x-16)$

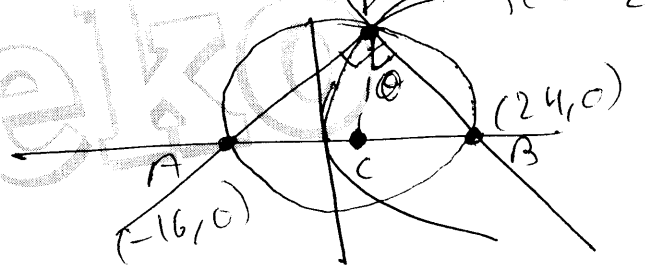
$y=0$

$x=-16$

$-16=-2x+32$

$-48=-2x$

$x=24$



$C\equiv(4,0)$

slope of $CP = \frac{16}{12} = \frac{4}{3}$

slope of $PB = -2$

$\tan\theta = \left|\frac{\frac{4}{3}+2}{1-\frac{8}{3}}\right| = \left|\frac{10}{-5}\right|$

$\tan\theta = 2$; Ans

(23) Let $f(x) = |x-\pi|\cdot(e^{|x|}-1)\sin|x| \cdots ?$

PTO

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$$f(x)=\begin{cases}-(x-\pi)(e^{-x}-1)(-(\sin x)) & x<0\\ -(x-\pi)(e^{x}-1)(\sin x) & x\geq 0\end{cases}$$

$$f(x)=\begin{cases}-(x-\pi)(e^{x}-1)\sin x & x<\pi\\ (x-\pi)(e^{x}-1)\sin x & x\geq\pi\end{cases}$$

$x=0$ $\quad x=\pi$

LHL 0 $\quad$ RHL $=0$

LHD $f(x)=(x-\pi)(e^{-x}-1)(\sin x)$

$f'(x)=(x-\pi)(e^{-x}-1)(\cos x$
$+(x-\pi)(\sin x)(e^{-x})(-1)$
$+(\sin x)(e^{-x}-1)$

$f'(1)=0$

RHD $f'(x)=-[(x-\pi)(e^{x}-1)\sin x]$

$f'(1)=-[(e^{x}-1)\sin x$
$+(e^{x}-1)(\cos x)(x-\pi)$
$+(e^{x}-1)\sin x(1-\pi)$
0

diff at $x=0$

Similarly

$\therefore$ Empty set Ans