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96 Selections in JEE Main 2015 & 21 Selections in JEE Advanced 2015 Also Available Online www.MathsBySuhag.com

56 Students Selected in JEE Advanced 2016 out of 129 JEE Main 2016 Selection Success Ratio 43%

Also JEE Main 2016 Maths Marks 115/120 Siddharth Agrawal, 100/120 Himanshu Shukla, 100/120 Nikhil Jaiswal,

93/120 Swastik Sharma, 93/120 Shashwat Rangnekar & Our 112+ Students Selected for Advanced

46 Students, Scored 90% or More in Maths Class 12 (8 in M. P. Board with state Rank 7th Shivansh Maheshwari) (38 in CBSE)

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SUCCESS RATIO 55 %

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JEE Main अन. Set D Page - 1

Q. If curve $y^2 = 6x$... ?

(A) Tangent to $y^2 = 6x$. $y \cdot y_1 = 3(x + x_1)$ (1)

Tangent to $ax^2 + by^2 = 16$

$$axx_1 + byy_1 = 16$$

$$byy_1 = -axx_1 + 16$$

$$y = \frac{-ax_1x + 16}{by_1}$$

$$\text{Slope} = -\frac{ax_1}{by_1}$$

Slope $\frac{3}{y_1}$

$$\frac{3}{y_1} \times -\frac{a}{b} \times \frac{x_1}{y_1} = -1 \quad (\text{curves are orthogonal})$$

$$+ 27 \times \frac{x_1}{y_1^2} = +1 \quad \Rightarrow \quad 27 \times \frac{1}{6} = \left(\frac{y_1}{2}\right)$$

(2) $y_1^2 = 6x_1 \Rightarrow \frac{1}{6} = \frac{x_1}{y_1^2}$ let u coplanar. ?
Ans P.T.O.

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

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

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

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

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

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

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

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

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

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

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

$$b + c = 24$$

$$\rightarrow 3b = 24 \Rightarrow b = 8$$

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

$$8b - 4c = 0$$

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

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$$b + c = 24$$

$$8 + c = 24$$

$$c = 16$$

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

$$2a + 24 - 16 = 0$$

$$2a = -8$$

$$a = -4$$

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

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

$$\sqrt{16 + 64 + 256}$$

$$\begin{array}{r} 11 \\ 256 \\ 64 \\ 16 \\ \hline 336 \end{array}$$

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

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

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A

The value of $\int_{-\pi/2}^{\pi/2} \frac{\sin^2 x}{1+2^x} dx$ Page 4

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

$I = \int_{-\pi/2}^{\pi/2} \frac{\sin^2(\frac{\pi}{2}-\frac{\pi}{2}-x)}{1+2^{\frac{\pi}{2}-\frac{\pi}{2}-x}} dx$ proper $f(x) = f(a+b-x)$

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

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

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

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

$2I = 2 \int_0^{\pi/2} \sin^2 x dx$

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

$I = \frac{\pi}{4}$ ANS P.T.O

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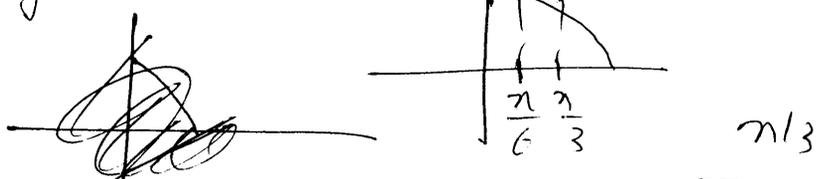
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(6) $g(x) = \cos x^2$ $f(x) = \sqrt{x}$ Page 5

(B) $18x^2 - 9\pi x + \pi^2 = 0$
 $18x^2 - 6\pi x - 3\pi x + \pi^2 = 0$
 $6x(3x - \pi) - \pi(3x - \pi) = 0$
 $(3x - \pi)(6x - \pi) = 0$
 $x = \frac{\pi}{3}$ $x = \frac{\pi}{6}$
 $\alpha = \frac{\pi}{6}$ $\beta = \frac{\pi}{3}$

$g \circ f(x) = \cos x$



$\int_{\pi/6}^{\pi/3} \cos x dx = [\sin x]_{\pi/6}^{\pi/3}$
 $\frac{\sqrt{3}}{2} - \frac{1}{2} = \frac{1}{2}(\sqrt{3} - 1)$

(7) If sum of all solutions \dots $8 \cos(\cos) \dots$

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

$4 \cos x (2 \cos(\frac{\pi}{6} + x) \cos(\frac{\pi}{6} - x) - 1) = 1$ P.T.O

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

Page 6

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

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

$$4 (\cos x)^4 (\cos 2x) - 2 (\cos x)^4 = 1$$

$$4 (\cos x)^4 (\cos 2x) = 1 + 2 (\cos x)^4$$

$$2 (2 (\cos x)^4 (\cos 2x)) = 1 + 2 (\cos x)^4$$

$$2 (\cos^4 x + \cos^6 x) = 1 + 2 (\cos x)^4$$

$$2 (\cos^6 x) = 1$$

$$(\cos^6 x) = \frac{1}{2}$$

$$0 < x < \pi$$

$$0 \leq 3x \leq 3\pi$$

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

$$3x \rightarrow \frac{2\pi}{3}, \frac{5\pi}{3}, \frac{7\pi}{3}$$

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

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

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(10) A bag contains 4 Red, 6 Black ball - ? Page 8

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 = $\frac{6 \times 4 + 4 \times 6}{6 \times 4 + 6 \times 4 + 6 \times 4 + 8 \times 6}$ = $\frac{48}{120} = \frac{4}{10} = 2$

= 2

S Ans

P.T.O

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सिरीट Set D

(11) Let the orthocentre and centroid ... ? Page 9

(4) $A \leftarrow 2 \rightarrow B \leftarrow 1 \rightarrow C(h, k)$
 $(-3, 5) \quad (3, 3)$

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)

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

$$= \sqrt{90}$$

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

Ans

(12) If tangent at (1, 7) ... ? P.T.O

$$y^2 = 4x - 6$$

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

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Eqn of Circle $x^2 + y^2 + 16x + 12y + c = 0$ Set D Page 10

Eqⁿ of Tangent ~~$y - 7 = 2(x - 1)$~~

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

$$y - 7 = 2x - 2$$

$$y - 2x - 5 = 0$$

Tangent to Circle $x^2 + y^2 + 16x + 12y + c = 0$
& centre $(-8, -6)$

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

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

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

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

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

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

$$5 = 100 - c$$

$$c = 95 \text{ Ans}$$

PTC

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सहित Set - D

(13) $\alpha, \beta \in \mathbb{C} \dots \dots x^2 - 11x + 1 = 0 \dots \dots$ Page 11

(D)

$x^2 - x + 1 = 0$

roots $\frac{1 \pm \sqrt{3}i}{2}$ $\begin{matrix} \swarrow & \searrow \\ -\omega & \rightarrow \alpha \\ & -\omega^2 \rightarrow \beta \end{matrix}$

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

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

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

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

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

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

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

\Rightarrow Ans 1

(14)
(B)

PQR is triangular park ... ?

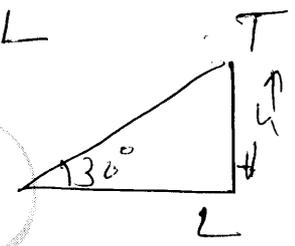
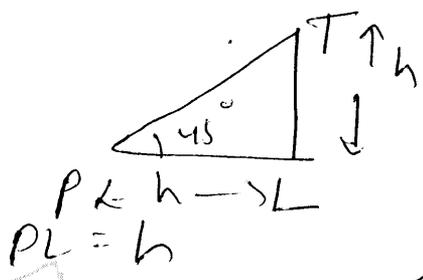
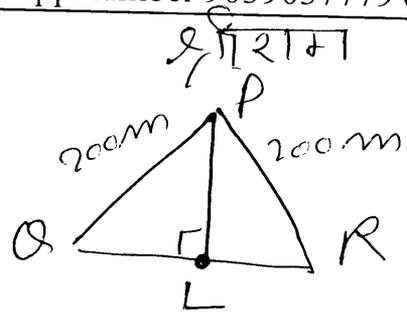
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in ΔPLO

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

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

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

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

$$h^2 = (100)^2$$

$\tan 30^\circ = \frac{h}{QL}$

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

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

$h = 100$ Ans

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

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

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

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

P.T.O

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2) $(x^2+1)^5$ Sect D Page 13

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

$$= 2 \left[5C_0 x^5 + 5C_2 x^6 - 5C_2 x^3 + 5C_4 (x^4 - 2x^2 + 1) \right]$$

$$= 2 \left[5C_0 x^5 + 5C_2 x^6 - 5C_2 x^3 + 5C_4 x^4 - 10C_4 x^2 + 5C_4 \right]$$

sum of odd coeffⁿ

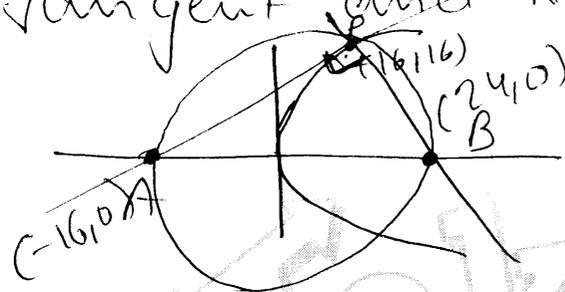
$$2 \left[5C_0 - 5C_2 + 2 \cdot 5C_4 \right]$$

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

$$2(1) = 2 \text{ Ans}$$

22
C

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



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

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

$$m_T = \frac{8}{4} = 2$$

$$m_{NI} = -\frac{1}{2}$$

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श्री 21+1 set-D

Page-14

Tang = $y - 16 = \frac{1}{2}(x - 16)$ Normal
 $(y - 16) = -2(x - 16)$
 $-16 = -2x + 32$
 $-48 = -2x$
 $x = 24$

$y = 0$
 $x = -16$

$C = (4, 0)$
 slope of CP

$= \frac{16}{12} = \frac{4}{3}$

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

$\tan \theta = 2$; Ans

(23)

~~(let f(x)) = |x - x| - (e^{|x|} - 1) \sin |x| - ... ?~~

~~at x = 0 RHL LHL~~ P.T.O

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

Set D
Page 15

$x = 0$

RHL = 0

$x = \pi$

Similarly

LHL

LHD

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

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

$f''(x) = 0$

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

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

diff at $x = 0$

Empty set
Ans