

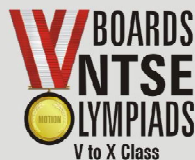
हमारा विश्वास... हर एक विद्यार्थी है स्वास

**JEE  
MAIN  
JAN  
2020**

**PAPER WITH SOLUTION**

**9<sup>th</sup> January 2020 \_ SHIFT - 1**

**MATHEMATICS**



**24000+**  
SELECTIONS SINCE 2007

JEE (Advanced)

**5392**

(Under 50000 Rank)

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**16241**

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1. The number of real roots of the equation,  $e^{4x} + e^{3x} - 4e^{2x} + e^x + 1 = 0$  is:

समीकरण  $e^{4x} + e^{3x} - 4e^{2x} + e^x + 1 = 0$  के वास्तविक मूलों की संख्या है :

- (1) 1 (2) 3 (3) 4 (4) 2

**Sol. 1**

let  $e^x = t$

$$= t^4 + t^3 - 4t^2 + t + 1 = 0$$

$$= \left(t^2 + \frac{1}{t^2}\right) + \left(t + \frac{1}{t}\right) - 4 = 0$$

$$= \left(t + \frac{1}{t}\right)^2 + \left(t + \frac{1}{t}\right) - 6 = 0$$

$$\Rightarrow u^2 + u - 6 = 0$$

$$\Rightarrow (u+3)(u-2) = 0$$

$$t + \frac{1}{t} - 2 = 0 \quad ; \quad t + \frac{1}{t} + 3 = 0 \text{ (Not possible)}$$

$$\Rightarrow t^2 - 2t + 1 = 0$$

$$\Rightarrow t = 1$$

$$\Rightarrow e^x = 1$$

$$\Rightarrow x = 0$$

2. Negation of the statement :

$\sqrt{5}$  is an integer or 5 is irrational is :

- (1)  $\sqrt{5}$  is an integer and 5 is irrational.  
 (2)  $\sqrt{5}$  is not an integer and 5 is not irrational.  
 (3)  $\sqrt{5}$  is not an integer or 5 is not irrational.  
 (4)  $\sqrt{5}$  is irrational or 5 is an integer.

कथन, ' $\sqrt{5}$  एक पूर्णांक है या अपरिमेय है' का निषेधन है :

- (1)  $\sqrt{5}$  एक पूर्णांक नहीं है या 5 अपरिमेय नहीं है।  
 (2)  $\sqrt{5}$  एक पूर्णांक नहीं है या 5 अपरिमेय नहीं है।  
 (3)  $\sqrt{5}$  एक पूर्णांक है और 5 अपरिमेय है।  
 (4)  $\sqrt{5}$  अपरिमेय है या 5 एक पूर्णांक है।

**Sol. 2**

$$\sim(p \vee q) = \sim p \wedge \sim q$$

3. The value of  $\int_0^{2\pi} \frac{x \sin^8 x}{\sin^8 x + \cos^8 x} dx$  is equal

$\int_0^{2\pi} \frac{x \sin^8 x}{\sin^8 x + \cos^8 x} dx$  का मान है :

- (1)  $4\pi$                       (2)  $2\pi^2$                       (3)  $2\pi$                       (4)  $\pi^2$

**Sol. 4**

$$I = \int_0^{2\pi} \frac{x \sin^8 x}{\sin^8 x + \cos^8 x} dx \dots(1)$$

$$I = \int_0^{2\pi} \frac{(2\pi - x) \sin^8 x}{\sin^8 x + \cos^8 x} dx \dots(2)$$

On adding eq.1 & 2

$$2I = 2\pi \int_0^{2\pi} \frac{\sin^8 x}{\sin^8 x + \cos^8 x} dx$$

$$I = 4\pi \int_0^{\pi/2} \frac{\sin^8 x}{\sin^8 x + \cos^8 x} dx \dots(3)$$

$$I = 4\pi \int_0^{\pi/2} \frac{\cos^8 x}{\cos^8 x + \sin^8 x} dx \dots(4)$$

On adding eq.3 and 4

$$\Rightarrow 2I = 4\pi \int_0^{\pi/2} 1 \cdot dx$$

4. The value of

$$\cos^3\left(\frac{\pi}{8}\right) \cdot \cos\left(\frac{3\pi}{8}\right) + \sin^3\left(\frac{\pi}{8}\right) \cdot \sin\left(\frac{3\pi}{8}\right) \text{ is :}$$

$$\cos^3\left(\frac{\pi}{8}\right) \cdot \cos\left(\frac{3\pi}{8}\right) + \sin^3\left(\frac{\pi}{8}\right) \cdot \sin\left(\frac{3\pi}{8}\right) \text{ का मान है :}$$

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

**Sol. 4**

$$= \cos^3 \frac{\pi}{8} \sin \frac{\pi}{8} + \sin^3 \frac{\pi}{8} \cos \frac{\pi}{8}$$

$$= \left( \sin \frac{\pi}{8} \times \cos \frac{\pi}{8} \right) \times 1$$

$$= \frac{1}{2} \times \sin \frac{\pi}{4} = \frac{1}{2\sqrt{2}}$$

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percentile between 97.0 to 98.99  
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score 160-200

Fees - ₹ 5500  
score 200-240

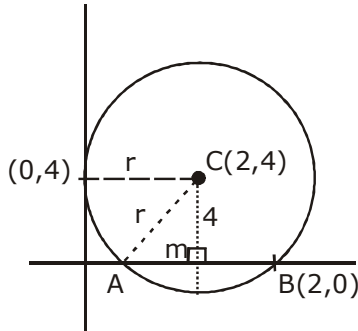
Fees - ₹ 0  
score above 240

5. A circle touches the y-axis at the point (0,4) and passes through the point (2,0). Which of the following lines is not a tangent to this circle ?

एक वृत्त y-अक्ष को बिन्दु (0, 4) पर स्पर्श करता है तथा बिन्दु (2, 0) से होकर जाता है। निम्न में से कौन सी रेखा इस वृत्त की स्पर्श रेखा नहीं है ?

(1)  $3x-4y-24 = 0$  (2)  $4x - 3y + 17 = 0$  (3)  $3x + 4y - 6 = 0$  (4)  $4x + 3y - 8 = 0$

Sol. 4



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

Passes through (2,0)

$$4 + 16 + 2\lambda = 0$$

$$\lambda = -10$$

$$x^2 + y^2 - 8x + 16 - 10x = 0$$

$$C(5,4), r = \sqrt{25 + 16 - 16} = 5$$

$$\text{Option(1)} \quad p = \frac{|15 - 16 - 24|}{5} = 5$$

$$\text{Option(2)} \quad p = \frac{|20 - 12 + 17|}{5} = 5$$

$$\text{Option(3)} \quad p = \frac{|15 + 16 - 6|}{5} = 5$$

$$\text{Option(4)} \quad p = \frac{|20 + 12 - 8|}{5} \neq 5$$

6. Let z be a complex number such that

$$\left| \frac{z-i}{z+2i} \right| = 1 \text{ and } |z| = \frac{5}{2}. \text{ Then the value of } |z+3i| \text{ is :}$$

माना z एक ऐसी सम्मिश्र संख्या है, कि  $\left| \frac{z-i}{z+2i} \right| = 1$  है तथा  $|z| = \frac{5}{2}$  है, तो  $|z+3i|$  का मान है :

(1)  $\frac{7}{2}$

(2)  $\frac{15}{4}$

(3)  $2\sqrt{3}$

(4)  $\sqrt{10}$

Sol. 1

$$\left| \frac{z-i}{z+2i} \right| = 1, |z| = \frac{5}{2} \Rightarrow x^2 + (y-1)^2 = x^2 + (y+2)^2$$

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$$\Rightarrow y = -\frac{1}{2} \quad \dots(1) \quad \Rightarrow |z| = \frac{5}{2}$$

$$x^2 + y^2 = \frac{25}{4}$$

from eq.(1)

$$\Rightarrow x = \pm\sqrt{6}$$

$$z = \sqrt{6} - \frac{i}{2} \text{ or } -\sqrt{6} - \frac{i}{2}$$

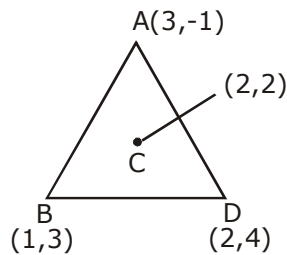
$$|z+3i| = \left| \sqrt{6} - \frac{i}{2} + 3i \right| \text{ or } \left| -\sqrt{6} - \frac{i}{2} + 3i \right| \Rightarrow \sqrt{6 + \frac{25}{4}} = \sqrt{\frac{49}{4}} = \frac{7}{2}$$

7. Let C be the centroid of the triangle with vertices (3, -1), (1,3) and (2,4). Let P be the point of intersection of the lines  $x + 3y - 1 = 0$  and  $3x - y + 1 = 0$ . Then the line passing through the points C and P also passes through the point.

माना शीर्षों (3, -1), (1,3) तथा (2,4) वाले त्रिभुज का केन्द्रक C है। माना रेखाओं  $x + 3y - 1 = 0$  तथा  $3x - y + 1 = 0$  का प्रतिच्छेदन बिन्दु P है, तो बिन्दुओं C तथा P से गुजरने वाली रेखा, निम्न में से किस बिन्दु से भी गुजरती है?

- (1) (-9, -7)                      (2) (9,7)                      (3) (7,6)                      (4) (-9, -6)

Sol. 4



$$P: x + 3y - 1 = 0 \quad \dots(1)$$

$$3x - y + 1 = 0 \quad \dots(2)$$

On solving eq.(1) and (2)

$$x = -\frac{1}{5}, y = \frac{2}{5}$$

eq. of line CP :

$$= y - 2 = \left( \frac{\frac{2}{5} - 2}{-\frac{1}{5} - 2} \right) (x - 2)$$

$$\Rightarrow 8x - 11y + 6 = 0$$

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score 200-240

Fees - ₹ 0  
score above 240

8. If the number of five digit numbers with distinct digits and 2 at the 10<sup>th</sup> place is 336k, then k is equal to :

यदि विभिन्न अंकों वाली पांच अंकों की संख्याओं, जिनका दहाई का अंक 2 है, की संख्या 336k है, तो k बराबर है :

- (1) 4 (2) 6 (3) 8 (4) 7

Sol.

$$\begin{array}{cccccc} 3 & & & & & \\ 8 & 8 & 7 & 1 & 6 & \\ \uparrow & \uparrow & \uparrow & \uparrow & \uparrow & \end{array}$$

(2)

$$8 \times 8 \times 7 \times 6 = 336k$$

$$k = 8$$

9. The integral  $\int \frac{dx}{(x+4)^{8/7} (x-3)^{6/7}}$  is equal to : (where C is a constant of integration)

समाकल  $\int \frac{dx}{(x+4)^{8/7} (x-3)^{6/7}}$  बराबर है : (जहाँ C एक समाकलन अचर है)

- (1)  $\frac{1}{2} \left( \frac{x-3}{x+4} \right)^{3/7} + C$  (2)  $\left( \frac{x-3}{x+4} \right)^{1/7} + C$  (3)  $-\left( \frac{x-3}{x+4} \right)^{-1/7} + C$  (4)  $-\frac{1}{13} \left( \frac{x-3}{x+4} \right)^{-13/7} + C$

Sol. 2

$$\int \frac{dx}{(x+4)^{8/7} (x-3)^{6/7}}$$

$$\int \frac{dx}{(x+4)^2 \left( \frac{x-3}{x+4} \right)^{6/7}}$$

Put  $\frac{x-3}{x+4} = t^7$

$$\left( \frac{(x+4) - (x-3)}{(x+4)^2} \right) dx = 7t^6 dt$$

$$\frac{7}{(x+4)^2} dx = 7t^6 dt$$

$$\int \frac{t^6}{t^6} dt = \left( \frac{x-3}{x+4} \right)^{1/7} + C$$

10. If  $f(x) = \begin{cases} \frac{\sin(a+2)x + \sin x}{x} & ; x < 0 \\ b & ; x = 0 \\ \frac{(x+3x^2)^{1/3} - x^{1/3}}{x^{4/3}} & ; x > 0 \end{cases}$

is continuous at  $x = 0$ , then  $a + 2b$  is equal to :

यदि  $f(x) = \begin{cases} \frac{\sin(a+2)x + \sin x}{x} & ; x < 0 \\ b & ; x = 0 \\ \frac{(x+3x^2)^{1/3} - x^{1/3}}{x^{4/3}} & ; x > 0 \end{cases}$

$x = 0$  पर संतत है, तो  $a + 2b$  का मान है :

- (1) 1 (2) 0 (3) -1 (4) -2

Sol. 2

$$f(0^-) = \lim_{h \rightarrow 0} \frac{\sin(a+2)h + \sin h}{h}$$

$$= \lim_{h \rightarrow 0} \frac{2 \sin\left(\frac{a+3}{2}\right)h \cos\left(\frac{a+1}{2}\right)h}{\frac{(a+3)}{2} \times h} \times \frac{(a+3)}{2} = a + 3$$

$$= f(0^+) = \lim_{h \rightarrow 0} \frac{(h+3h^2)^{1/3} - h^{1/3}}{h^{4/3}}$$

$$= f(0^+) = \lim_{h \rightarrow 0} \frac{1+h-1}{h} = 1$$

$$= a + 3 = 1 = b$$

$$a = -2, b = 1$$

$$a + 2b = 0$$

11. The product

$2^{\frac{1}{4}} \cdot 4^{\frac{1}{16}} \cdot 8^{\frac{1}{48}} \cdot 16^{\frac{1}{128}} \dots$  to  $\infty$  is equal to :

गुणनफल  $2^{\frac{1}{4}} \cdot 4^{\frac{1}{16}} \cdot 8^{\frac{1}{48}} \cdot 16^{\frac{1}{128}} \dots \infty$  तक बराबर है :

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

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score 200-240

Fees - ₹ 0  
score above 240

**Sol. 2**

$$= 2^{1/4} \cdot 2^{1/8} \cdot 2^{1/16} \cdot 2^{1/32} \dots$$

$$= 2^{\frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \frac{1}{32} + \dots} = 2^{\frac{1}{4} \cdot \frac{1}{1-1/2}} = 2^{1/2}$$

**12.** If  $f'(x) = \tan^{-1}(\sec x + \tan x)$ ,  $-\frac{\pi}{2} < x < \frac{\pi}{2}$ , and  $f(0) = 0$ , then  $f(1)$  is equal to :

यदि  $f'(x) = \tan^{-1}(\sec x + \tan x)$ ,  $-\frac{\pi}{2} < x < \frac{\pi}{2}$  है तथा  $f(0) = 0$  है, तो  $f(1)$  का मान है :

(1)  $\frac{\pi+2}{4}$

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

(3)  $\frac{\pi+1}{4}$

(4)  $\frac{\pi-1}{4}$

**Sol. 3**

$$= f'(x) = \tan^{-1} \left[ \frac{1 + \sin x}{\cos x} \right]$$

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

$$= f'(x) = \frac{\pi}{4} + \frac{x}{2}, \begin{cases} -\frac{\pi}{4} < \frac{x}{2} < \frac{\pi}{4} \\ 0 < \frac{x}{2} + \frac{\pi}{4} < \frac{\pi}{2} \end{cases}$$

$$= f(x) = \frac{\pi x}{4} + \frac{x^2}{4} + C$$

$$f(0) = 0 \Rightarrow C = 0$$

$$= f(x) = \frac{\pi x}{4} + \frac{x^2}{4} = f(1) = \frac{\pi+1}{4}$$

**13.** Let  $f$  be any function continuous on  $[a, b]$  and twice differentiable on  $(a, b)$ . If for all  $x \in (a, b)$ ,  $f'(x) > 0$

and  $f''(x) < 0$ , then for any  $c \in (a, b)$ ,  $\frac{f(c) - f(a)}{f(b) - f(c)}$  is greater than :

माना  $f$  कोई फलन है जोकि  $[a, b]$  में संतत तथा  $(a, b)$  में दो बार अवकलनीय है। यदि सभी  $x \in (a, b)$  के लिए  $f'(x) > 0$

तथा  $f''(x) < 0$  हैं, तो किसी भी  $c \in (a, b)$  के लिए  $\frac{f(c) - f(a)}{f(b) - f(c)}$  निम्न में से किससे बड़ा है ?

(1)  $\frac{c-a}{b-c}$

(2)  $\frac{b-c}{c-a}$

(3)  $\frac{b+c}{b-a}$

(4) 1

**Sol. 1**

$$f'(x) > 0 \text{ \& } f''(x) < 0$$

Apply LMVT on  $[a, c]$

$$f'(\alpha) = \frac{f(c) - f(a)}{c - a}$$

Apply LMVT on  $[c, b]$

$$f'(\beta) = \frac{f(b) - f(c)}{b - c}$$

$f''(x) < 0 \Rightarrow f'(x)$  is decreasing



$$f'(\alpha) > f'(\beta)$$

$$\frac{f(c) - f(a)}{c - a} > \frac{f(b) - f(c)}{b - c}$$

$$\frac{f(c) - f(a)}{f(b) - f(c)} > \frac{c - a}{b - c}$$

- 14.** Let the observations  $x_i (1 \leq i \leq 10)$  satisfy the equations,  $\sum_{i=1}^{10} (x_i - 5) = 10$  and  $\sum_{i=1}^{10} (x_i - 5)^2 = 40$ . If  $\mu$  and  $\lambda$  are the mean and the variance of the observations,  $x_1 - 3, x_2 - 3, \dots, x_{10} - 3$ , then the ordered pair  $(\mu, \lambda)$  is equal to :

माना प्रेक्षण  $x_i (1 \leq i \leq 10)$  समीकरणों  $\sum_{i=1}^{10} (x_i - 5) = 10$  तथा  $\sum_{i=1}^{10} (x_i - 5)^2 = 40$  को संतुष्ट करते हैं। यदि  $\mu$  तथा  $\lambda$ , प्रेक्षणों

$x_1 - 3, x_2 - 3, \dots, x_{10} - 3$  के क्रमशः माध्य तथा प्रसरण हैं, तो क्रमित युग्म  $(\mu, \lambda)$  बराबर है :

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

**Sol. 1**

$$\sum_{i=1}^{10} (x_i - 5) = 10$$

$$x_1 + x_2 + \dots + x_{10} = 10 + 50 = 60$$

$$\sum_{i=1}^{10} (x_i - 5)^2 = 40$$

$$(x_1^2 + x_2^2 + \dots + x_{10}^2) + 250 - 10(60) = 40$$

$$x_1^2 + \dots + x_{10}^2 = 640 - 250 = 390$$

$$\text{Mean} = \frac{x_1 + \dots + x_{10} - 30}{10}$$

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$$= \frac{60 - 30}{10} = 3 = \mu$$

$$\text{Variance} = \frac{\sum x_i^2}{n} - (\bar{x})^2$$

$$= \frac{(x_1 - 3)^2 + \dots + (x_{10} - 3)^2}{10} - 3^2$$

$$= \frac{390 + 90 - 6 \times 60}{10} - 3^2 = 3$$

- 15.** A spherical iron ball of 10 cm radius is coated with a layer of ice of uniform thickness that melts at a rate of  $50 \text{ cm}^3 / \text{min}$ . When the thickness of ice is 5 cm, then the rate (in cm/min.) at which of the thickness of ice decreases, is :

एक 10 cm त्रिज्या वाली गोलाकार लोहे की गेंद को बर्फ की एक समान मोटाई वाली परत से लेप किया गया है, जो कि  $50 \text{ cm}^3 / \text{min}$  की दर से पिघलती है। जब बर्फ की परत की मोटाई 5 cm है, उस समय बर्फ की मोटाई के घटने की दर (cm/min में), है :

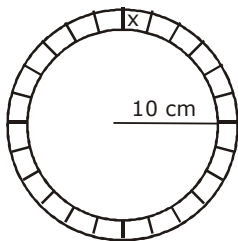
(1)  $\frac{1}{18\pi}$

(2)  $\frac{5}{6\pi}$

(3)  $\frac{1}{36\pi}$

(4)  $\frac{1}{54\pi}$

**Sol. 1**



$$V = \frac{4}{3} \pi (r+x)^3$$

$$V = \frac{4}{3} \pi (10+x)^3$$

$$\frac{dv}{dt} = 4\pi (10+x)^2 \frac{dx}{dt}$$

$$50 = 4\pi (10+x)^2 \frac{dx}{dt}$$

$$\frac{dx}{dt} = \frac{50}{4\pi (15)^2} = \frac{50}{4\pi \times 15 \times 15} = \frac{1}{18\pi} \text{ cm/min}$$



16. If the matrices  $A = \begin{bmatrix} 1 & 1 & 2 \\ 1 & 3 & 4 \\ 1 & -1 & 3 \end{bmatrix}$ ,  $B = \text{adj } A$  and  $C = 3A$ , then  $\frac{|\text{adj } B|}{|C|}$  is equal to :

यदि आव्यूह  $A = \begin{bmatrix} 1 & 1 & 2 \\ 1 & 3 & 4 \\ 1 & -1 & 3 \end{bmatrix}$ ,  $B = \text{adj } A$  तथा  $C = 3A$  हैं, तो  $\frac{|\text{adj } B|}{|C|}$  का मान है :

Sol. 1 (1) 8 (2) 2 (3) 16 (4) 72

$$\frac{|\text{adj}(\text{adj}A)|}{|C|} = \frac{|A|^{(n-1)^2}}{|C|}$$

$$d = \frac{(6)^{(3-1)^2}}{3^3 |A|} = \frac{6^4}{6 \times 27} = 8$$

17. If for all real triplets  $(a, b, c)$ ,  $f(x) = a + bx + cx^2$ ; then  $\int_0^1 f(x) dx$  is equal to :

यदि सभी वास्तविक त्रिकों  $(a, b, c)$  के लिए,  $f(x) = a + bx + cx^2$  है, तो  $\int_0^1 f(x) dx$  बराबर है :

(1)  $2 \left\{ 3f(1) + 2f\left(\frac{1}{2}\right) \right\}$  (2)  $\frac{1}{2} \left\{ f(1) + 3f\left(\frac{1}{2}\right) \right\}$  (3)  $\frac{1}{3} \left\{ f(0) + f\left(\frac{1}{2}\right) \right\}$  (4)  $\frac{1}{6} \left\{ f(0) + f(1) + 4f\left(\frac{1}{2}\right) \right\}$

Sol. 4

$$\Rightarrow \int_0^1 (a + bx + cx^2) dx$$

$$\left( ax + \frac{bx^2}{2} + \frac{x^3}{3} \right)_0^1$$

$$a + \frac{b}{2} + \frac{c}{3} \Rightarrow \frac{6a + 3b + 2c}{6} \text{ Now } f(1) = a + b + c$$

$$f\left(\frac{1}{2}\right) = a + \frac{b}{2} + \frac{c}{4}$$

$$f(0) = 0$$

$$(A) 2 \{ 3(a+b+c) + 2a + b + c/2 \} \\ = 2 \{ 5a + 4b + 7c/2 \}$$

$$(B) \frac{1}{2} \left\{ a + b + c + 3a + \frac{3b}{2} + \frac{3c}{4} \right\}$$

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20. If for some  $\alpha$  and  $\beta$  in  $\mathbb{R}$ , the intersection of the following three planes

$$x + 4y - 2z = 1$$

$$x + 7y - 5z = \beta$$

$$x + 5y + \alpha z = 5$$

is a line in  $\mathbb{R}^3$ , then  $\alpha + \beta$  is equal to :

यदि  $\mathbb{R}$  में किन्हीं  $\alpha$  तथा  $\beta$  के लिए, निम्न तीन समतलों

$$x + 4y - 2z = 1$$

$$x + 7y - 5z = \beta$$

$$x + 5y + \alpha z = 5$$

का प्रतिच्छेदन,  $\mathbb{R}^3$  में एक रेखा है, तो  $\alpha + \beta$  का मान है :

(1) 0

(2) -10

(3) 10

(4) 2

Sol.

3

$$\Delta = 0$$

$$\begin{vmatrix} 1 & 4 & -2 \\ 1 & 7 & -5 \\ 1 & 5 & \alpha \end{vmatrix} = 0$$

$$1(7\alpha + 25) - 4(\alpha + 5) - 2(5 - 7) = 0$$

$$7\alpha + 25 - 4\alpha - 20 + 4 = 0$$

$$3\alpha + 9 = 0$$

$$\alpha = -3$$

also,

$$\Delta = \begin{vmatrix} 1 & 4 & 1 \\ 1 & 4 & \beta \\ 1 & 5 & 5 \end{vmatrix} = 0$$

$$= 1(35 - 5\beta) - 4(5 - \beta) + (-2) = 0$$

$$= 13 - \beta = 0$$

$$\beta = 13$$

21. If the vectors,  $\vec{p} = (a+1)\hat{i} + a\hat{j} + a\hat{k}$ ,  $\vec{q} = a\hat{i} + (a+1)\hat{j} + a\hat{k}$  and  $\vec{r} = a\hat{i} + a\hat{j} + (a+1)\hat{k}$  ( $a \in \mathbb{R}$ ) are coplanar

and  $3(\vec{p} \cdot \vec{q})^2 - \lambda |\vec{r} \times \vec{q}|^2 = 0$ , then the value of  $\lambda$  is

यदि सदिश  $\vec{p} = (a+1)\hat{i} + a\hat{j} + a\hat{k}$ ,  $\vec{q} = a\hat{i} + (a+1)\hat{j} + a\hat{k}$  तथा  $\vec{r} = a\hat{i} + a\hat{j} + (a+1)\hat{k}$  ( $a \in \mathbb{R}$ ) सहतलीय हैं तथा

$3(\vec{p} \cdot \vec{q})^2 - \lambda |\vec{r} \times \vec{q}|^2 = 0$  है, तो  $\lambda$  का मान है.....।

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score above 240

Sol. 1

$$[\vec{p} \vec{q} \vec{r}] = \begin{vmatrix} a+1 & a & a \\ a & a+1 & a \\ a & a & a+1 \end{vmatrix} = 0 \Rightarrow \begin{vmatrix} 1 & -1 & 0 \\ a & a+1 & a \\ 0 & -1 & 1 \end{vmatrix} = 0$$

$$1(a+1+a) + 1(a) = 0 \Rightarrow 3a + 1 = 0 \Rightarrow a = -1/3$$

$$\vec{p} = \frac{2}{3}, -\frac{1}{3}, -\frac{1}{3}; \vec{q} = -\frac{1}{3}, \frac{2}{3}, -\frac{1}{3}; \vec{r} = -\frac{1}{3}, -\frac{1}{3}, \frac{2}{3}$$

$$\vec{p} \cdot \vec{q} = -\frac{2}{9} - \frac{2}{9} + \frac{1}{9} = -\frac{4}{9} + \frac{1}{9} = -\frac{3}{9} = -\frac{1}{3} \Rightarrow \vec{r} \times \vec{q} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -\frac{1}{3} & \frac{2}{3} & -\frac{1}{3} \\ -\frac{1}{3} & -\frac{1}{3} & \frac{2}{3} \end{vmatrix}$$

$$= \left( \frac{1}{3}, \frac{1}{3}, \frac{1}{3} \right)$$

$$= 3 \times \frac{1}{9} - \lambda \left( \sqrt{\frac{3}{9}} \right)^2 = 0$$

$$\Rightarrow \lambda = 1$$

22. The coefficient of  $x^4$  in the expansion of  $(1+x+x^2)^{10}$  is  $(1+x+x^2)^{10}$  के प्रसार में  $x^4$  का गुणांक है .....

Sol. 615

$$= \frac{10!}{p!q!r!} (1)^p (x)^q (x^2)^r$$

$$= q + 2r = 4, p + q + r = 10$$

p	q	R
8	0	2
6	4	0
7	2	1

$$= \frac{10!}{8!2!} + \frac{10!}{6!4!} + \frac{10!}{7!2!}$$

$$= 45 + 210 + 360 = 615$$

23. If for  $x \geq 0, y = y(x)$  is the solution of the differential equation,  $(x+1)dy = ((x+1)^2 + y - 3)dx, y(2) = 0$ , then  $y(3)$  is equal to.....

यदि  $x \geq 0$  के लिए  $y = y(x)$ , अवकल समीकरण  $(x+1)dy = ((x+1)^2 + y - 3)dx, y(2) = 0$ , का हल है, तो  $y(3)$  का मान है .....

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Sol. 3

$$(x+1)dy = [(x+1)^2 + (y-3)]dx$$

$$\frac{dy}{dx} - \frac{y}{x+1} = x+1 - \frac{3}{x+1}$$

$$\Rightarrow \text{I.F.} = e^{-\int \frac{dx}{x+1}} = \frac{1}{x+1}$$

$$\Rightarrow \frac{y}{x+1} = \int \frac{x^2 + 2x - 2}{(x+1)^2} dx$$

$$\Rightarrow \frac{y}{x+1} = x + \frac{3}{x+1} + C$$

Equation passes through (2,0) then, C = -3

$$= \frac{y}{x+1} = x + \frac{3}{x+1} - 3$$

Put x = 3 then, y = 3

24. The number of distinct solutions of the equation,  $\log_{\frac{1}{2}} |\sin x| = 2 - \log_{\frac{1}{2}} |\cos x|$  in the interval  $[0, 2\pi]$  is .....

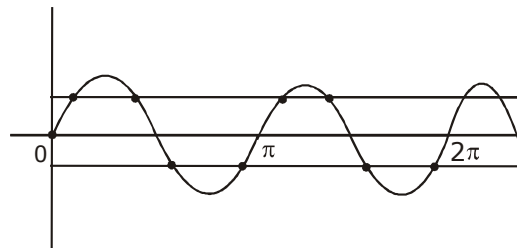
समीकरण  $\log_{\frac{1}{2}} |\sin x| = 2 - \log_{\frac{1}{2}} |\cos x|$  के अंतराल  $[0, 2\pi]$  में भिन्न हलों की संख्या है .....

Sol. 8

$$\log_{\frac{1}{2}} |\sin x| = 2 - \log_{\frac{1}{2}} |\cos x|$$

$$= |\sin x| |\cos x| = \frac{1}{4}$$

$$= \sin 2x = \pm \frac{1}{2}$$



25. The projection of the line segment joining the points (1, -1, 3) and (2, -4, 11) on the line joining the points (-1, 2, 3) and (3, -2, 10) is .....

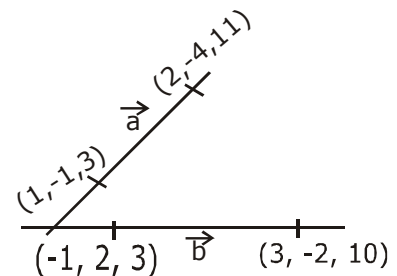
बिन्दुओं (1, -1, 3) तथा (2, -4, 11) को मिलाने वाले रेखाखण्ड का बिन्दुओं (-1, 2, 3) तथा (3, -2, 10) को मिलाने वाली रेखा पर प्रक्षेप है .....

Sol. 8

$$\vec{a} = 1, -3, 8$$

$$\vec{b} = 4, -4, 7$$

$$= \frac{\vec{a} \cdot \vec{b}}{|\vec{b}|} = \frac{4 + 12 + 56}{\sqrt{16 + 16 + 49}} = 8$$



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