

हमारा विश्वास... हर एक विद्यार्थी है खास

**JEE
MAIN
Sept.
2020**

QUESTION PAPER WITH SOLUTION

MATHEMATICS _ 5 Sep. _ SHIFT - 2



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Q.1 If $x=1$ is a critical point of the function $f(x)=(3x^2+ax-2-a)e^x$, then:

(1) $x=1$ is a local minima and $x = -\frac{2}{3}$ is a local maxima of f .

(2) $x=1$ is a local maxima and $x = -\frac{2}{3}$ is a local minima of f .

(3) $x=1$ and $x = -\frac{2}{3}$ are local minima of f .

(4) $x=1$ and $x = -\frac{2}{3}$ are local maxima of f .

यदि $x=1$, फलन $f(x)=(3x^2+ax-2-a)e^x$ का एक क्रांतिक बिन्दु है, तब

(1) $x=1$, f का एक स्थानिय निम्निष्ठ है तथा $x = -\frac{2}{3}$ f का एक स्थानिय उच्चिष्ठ है।

(2) $x=1$, f का एक स्थानिय उच्चिष्ठ है तथा $x = -\frac{2}{3}$ f का एक स्थानिय निम्निष्ठ है।

(3) $x=1$ तथा $x = -\frac{2}{3}$, f का स्थानिय निम्निष्ठ है।

(4) $x=1$ तथा $x = -\frac{2}{3}$, f का स्थानिय उच्चिष्ठ है।

Sol. 1

$$f(x) = (3x^2+ax-2-a)e^x$$

$$f'(x) = (3x^2+ax-2-a)e^x + (6x+a)e^x = 0$$

$$e^x [3x^2 + (a+6)x - 2] = 0$$

$$\text{at } x = 1, 3 + a + 6 - 2 = 0$$

$$a = -7$$

$$f(x) = (3x^2 - 7x + 5)e^x$$

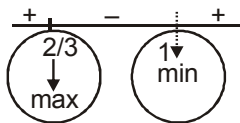
$$f'(x) = (6x-7)e^x + (3x^2-7x+5)e^x$$

$$= e^x(3x^2-x-2) = 0$$

$$= 3x^2 - 3x + 2x - 2 = 0$$

$$= (3x+2)(x-1) = 0$$

$$x = 1, -2/3$$



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Q.2 $\lim_{x \rightarrow 0} \frac{x \left(e^{\frac{(\sqrt{1+x^2+x^4}-1)/x}{-1}} \right)}{\sqrt{1+x^2+x^4}-1}$

- (1) is equal to \sqrt{e} (2) is equal to 1 (3) is equal to 0 (4) does not exist

$\lim_{x \rightarrow 0} \frac{x \left(e^{\frac{(\sqrt{1+x^2+x^4}-1)/x}{-1}} \right)}{\sqrt{1+x^2+x^4}-1}$

- (1) \sqrt{e} के बराबर है (2) 1 के बराबर है (3) 0 के बराबर है (4) विद्यमान नहीं है

Sol. 2

$\lim_{x \rightarrow 0} \frac{x \left[e^{\frac{(\sqrt{1+x^2+x^4}-1)/x}{-1}} - 1 \right]}{\left(\sqrt{1+x^2+x^4} - 1 \right)}$

$\lim_{x \rightarrow 0} \frac{x \left[e^{\frac{\left[\frac{(\sqrt{1+x^2+x^4}-1)}{x \times 2} \right]^2 - 1}{-1}} - 1 \right] \times \left(\sqrt{1+x^2+x^4} + 1 \right)}{(x^2 + x^4)}$

$\lim_{x \rightarrow \infty} \frac{e^{\frac{x^3+x}{2}} - 1}{\left(\frac{x^3+x}{2} \right) \times 2} \times 2$
= 1

Q.3 The statement $(p \rightarrow (q \rightarrow p)) \rightarrow (p \rightarrow (p \vee q))$ is:

- (1) equivalent to $(p \vee q) \wedge (\sim p)$
(2) equivalent to $(p \wedge q) \vee (\sim p)$
(3) a contradiction
(4) a tautology

कथन $(p \rightarrow (q \rightarrow p)) \rightarrow (p \rightarrow (p \vee q))$ है—

- (1) $(p \vee q) \wedge (\sim p)$ के बराबर
(2) $(p \wedge q) \vee (\sim p)$ के बराबर
(3) एक विरोधाभासी
(4) एक पुनरिक्ति

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Sol. 4

p	$q \rightarrow p$	$p \rightarrow (q \rightarrow p)$	
T	T	T	
T	T	T	
F	F	T	\Rightarrow (Tautology)
F	T	T	

p	$p \vee q$	$p \rightarrow (p \vee q)$
T	T	T
T	T	T
F	T	T
F	F	T

Q.4 If $L = \sin^2\left(\frac{\pi}{16}\right) - \sin^2\left(\frac{\pi}{8}\right)$ and $M = \cos^2\left(\frac{\pi}{16}\right) - \sin^2\left(\frac{\pi}{8}\right)$, then:

यदि $L = \sin^2\left(\frac{\pi}{16}\right) - \sin^2\left(\frac{\pi}{8}\right)$ तथा $M = \cos^2\left(\frac{\pi}{16}\right) - \sin^2\left(\frac{\pi}{8}\right)$ तब-

(1) $M = \frac{1}{2\sqrt{2}} + \frac{1}{2} \cos \frac{\pi}{8}$

(2) $M = \frac{1}{4\sqrt{2}} + \frac{1}{4} \cos \frac{\pi}{8}$

(3) $L = -\frac{1}{2\sqrt{2}} + \frac{1}{2} \cos \frac{\pi}{8}$

(4) $L = \frac{1}{4\sqrt{2}} - \frac{1}{4} \cos \frac{\pi}{8}$

Sol. 1

$$l = \sin\left(\frac{3\pi}{16}\right) \sin\left(\frac{-\pi}{16}\right)$$

$$l = \frac{-1}{2} \left[\cos \frac{\pi}{8} - \cos \frac{\pi}{4} \right]$$

$$l = \frac{1}{2\sqrt{2}} - \frac{1}{2} \cos \frac{\pi}{8}$$

$$M = \cos\left(\frac{3\pi}{16}\right) \cos\left(\frac{\pi}{16}\right)$$

$$M = \frac{1}{2} \left[\cos \frac{\pi}{4} + \cos \frac{\pi}{8} \right]$$

$$M = \frac{1}{2\sqrt{2}} + \frac{1}{2} \cos \frac{\pi}{8} \dots (1)$$

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Q.5 If the sum of the first 20 terms of the series $\log_{(7^{1/2})} x + \log_{(7^{1/3})} x + \log_{(7^{1/4})} x + \dots$ is 460, then x is equal to:

यदि श्रेणी $\log_{(7^{1/2})} x + \log_{(7^{1/3})} x + \log_{(7^{1/4})} x + \dots$ के पहले 20 पदों का योगफल 460 है तब x बराबर है—

- (1) $7^{1/2}$ (2) 7^2 (3) e^2 (4) $7^{46/21}$

Sol. 2

$$(2 + 3 + 4 + \dots + 21) \log_7 x = 460$$

$$\Rightarrow \frac{20 \times (21 + 2)}{2} \log_7 x = 460$$

$$\Rightarrow 230 \log_7 x = 460 \Rightarrow \log_7 x = 2 \Rightarrow x = 7^2$$

Q.6 There are 3 sections in a question paper and each section contains 5 questions. A candidate has to answer a total of 5 questions, choosing at least one question from each section. Then the number of ways, in which the candidate can choose the questions, is:

यहाँ एक प्रश्न पत्र में 3 खण्ड हैं तथा प्रत्येक खण्ड 5 प्रश्नों को रखता है। एक उम्मीदवार को प्रत्येक खण्ड से कम से कम एक प्रश्न का चयन करते हुये कुल 5 प्रश्नों का उत्तर देना होता है। तब उन तरिकों की संख्या, जिसमें उम्मीदवार प्रश्नों का चयन कर सकते हैं, होगी—

- (1) 2250 (2) 2255 (3) 1500 (4) 3000

Sol. 1

	S-1	S-2	S-3
	1,2,3,4,5	1,2,3,4,5	1,2,3,4,5
6 case	1	1	3
	1	2	2
	1	3	1
	2	2	1
	2	1	2
	3	1	1

$$3(5_{c_1} \times 5_{c_1} \times 5_{c_3}) + 3(5_{c_1} \times 5_{c_2} \times 5_{c_2}) = 3(25 \times 10) + (100 \times 5)3 = 750 + 1500 = 2250$$

Q.7 If the mean and the standard deviation of the data 3,5,7,a,b are 5 and 2 respectively, then a and b are the roots of the equation:

यदि आकड़ों 3,5,7,a,b का माध्य तथा मानक विलयन क्रमशः 5 तथा 2 है तब a तथा b निम्न समीकरण के मूल हैं—

- (1) $x^2 - 20x + 18 = 0$ (2) $x^2 - 10x + 19 = 0$ (3) $2x^2 - 20x + 19 = 0$ (4) $x^2 - 10x + 18 = 0$

Sol. 2

$$S.D. = \sqrt{\frac{\sum x_i^2}{n} - (\bar{x})^2}$$

$$(2)^2 = \frac{83 + a^2 + b^2}{5} - \left(\frac{15 + a + b}{5}\right)^2$$

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$$4 = \frac{83 + a^2 + b^2}{5} - 25$$

$$29 \times 5 - 83 = a^2 + b^2 \Rightarrow a^2 + b^2 = 62 \quad (1)$$

$$\frac{a + b + 15}{5} = 5 \Rightarrow \boxed{a + b = 10}$$

$$2ab = 100 - 62 = 38$$

$$\boxed{ab = 19} \quad (2)$$

Q.8 The derivative of $\tan^{-1}\left(\frac{\sqrt{1+x^2}-1}{x}\right)$ with respect to $\tan^{-1}\left(\frac{2x\sqrt{1-x^2}}{1-2x^2}\right)$ at $x = \frac{1}{2}$ is:

$x = \frac{1}{2}$ पर $\tan^{-1}\left(\frac{2x\sqrt{1-x^2}}{1-2x^2}\right)$ के सापेक्ष $\tan^{-1}\left(\frac{\sqrt{1+x^2}-1}{x}\right)$ का अवकलन है-

(1) $\frac{2\sqrt{3}}{3}$ (2) $\frac{2\sqrt{3}}{5}$ (3) $\frac{\sqrt{3}}{12}$ (4) $\frac{\sqrt{3}}{10}$

Sol. 4

$$x = \tan \theta$$

$$u = \tan^{-1}\left(\frac{\sec \theta - 1}{\tan \theta}\right) = \tan^{-1}(\tan \theta / 2) = \frac{\theta}{2} = \frac{\tan^{-1} x}{2}$$

$$v = \tan^{-1}\left(\frac{2 \sin \theta \cos \theta}{\cos 2\theta}\right) = 2\theta$$

$$= 2 \sin^{-1} x$$

$$\frac{du}{dv} = \frac{1}{2(1+x^2)} \times \frac{\sqrt{1-x^2}}{2}$$

$$= \frac{\sqrt{3}}{2 \times 2} \times \frac{4}{5 \times 2} = \frac{\sqrt{3}}{10}$$

Q.9 If $\int \frac{\cos \theta}{5 + 7 \sin \theta - 2 \cos^2 \theta} d\theta = A \log_e |B(\theta)| + C$ where C is a constant of integration, then $\frac{B(\theta)}{A}$ can be:

यदि $\int \frac{\cos \theta}{5 + 7 \sin \theta - 2 \cos^2 \theta} d\theta = A \log_e |B(\theta)| + C$ है, जहाँ C एक समाकलन का नियतांक है, तब $\frac{B(\theta)}{A}$ हो सकता है-

(1) $\frac{5(2 \sin \theta + 1)}{\sin \theta + 3}$ (2) $\frac{5(\sin \theta + 3)}{2 \sin \theta + 1}$ (3) $\frac{2 \sin \theta + 1}{\sin \theta + 3}$ (4) $\frac{2 \sin \theta + 1}{5(\sin \theta + 3)}$

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Sol. 1

$$\int \frac{\cos \theta}{5 + 7 \sin \theta - 2 + 2 \sin^2 \theta} d\theta$$

$$\int \frac{dt}{2t^2 + 7t + 3}$$

$$= \frac{1}{2} \int \frac{dt}{t^2 + \frac{7t}{2} + \frac{3}{2}} = \frac{1}{2} \int \frac{dt}{t^2 + \frac{7}{2}t + \left(\frac{7}{4}\right)^2 - \frac{49}{16} + \frac{24}{16}}$$

$$= \frac{1}{2} \int \frac{dt}{(t + 7/4)^2 - (5/4)^2}$$

$$\frac{1}{2} \times \frac{1}{2} \cdot \frac{5}{4} \ln \left| \frac{t + 7/4 - 5/4}{t + 7/4 + 5/4} \right|$$

$$\frac{1}{5} \ln \left| \frac{\sin \theta + 1/2}{\sin \theta + 3} \right| + C$$

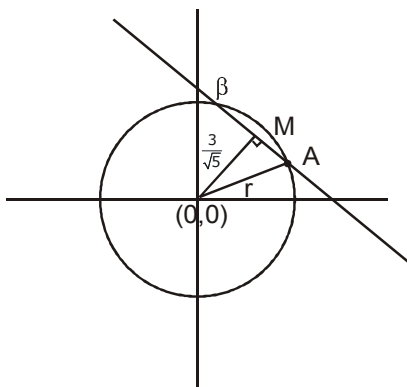
$$\frac{B(\theta)}{A} = 5 \left(\frac{2 \sin \theta + 1}{\sin \theta + 3} \right)$$

Q.10 If the length of the chord of the circle, $x^2 + y^2 = r^2 (r > 0)$ along the line, $y - 2x = 3$ is r , then r^2 is equal to:

रेखा $y - 2x = 3$ के अनुदिश वृत्त $x^2 + y^2 = r^2 (r > 0)$ की जीवा की लम्बाई निम्न के बराबर है—

- (1) 12 (2) $\frac{24}{5}$ (3) $\frac{9}{5}$ (4) $\frac{12}{5}$

Sol. 4



$$AB = 2\sqrt{r^2 - 9/5} = r$$

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$$r^2 - 9/5 = \frac{r^2}{4}$$

$$3r^2/4 = 9/5$$

$$\boxed{r^2 = \frac{12}{5}}$$

Q.11 If α and β are the roots of the equation, $7x^2 - 3x - 2 = 0$, then the value of $\frac{\alpha}{1-\alpha^2} + \frac{\beta}{1-\beta^2}$ is equal to:

यदि α तथा β समीकरण $7x^2 - 3x - 2 = 0$ के मूल हैं, तब $\frac{\alpha}{1-\alpha^2} + \frac{\beta}{1-\beta^2}$ का मान निम्न के बराबर है—

(1) $\frac{27}{32}$

(2) $\frac{1}{24}$

(3) $\frac{27}{16}$

(4) $\frac{3}{8}$

Sol.

3

$$\alpha + \beta = 3/7, \alpha\beta = -2/7$$

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

$$\frac{\frac{3}{7} + \frac{2}{7} \times \frac{3}{7}}{1 - \left\{ \frac{9}{49} + \frac{4}{7} \right\} + \frac{4}{49}}$$

$$\frac{\left(\frac{21+6}{49} \right)}{\frac{16}{49}} \Rightarrow \frac{27}{16}$$

Q.12 If the sum of the second, third and fourth terms of a positive term G.P. is 3 and the sum of its sixth, seventh and eighth terms is 243, then the sum of the first 50 terms of this G.P. is:

यदि एक धनात्मक पद वाली गुणोत्तर श्रेणी के द्वितीय तृतीय तथा चतुर्थ पदों का योगफल 3 है तथा इसके छठे, सातवें तथा आठवें पदों का योगफल 243 है तब इस गुणोत्तर श्रेणी के पहले 50 पदों का योगफल है—

(1) $\frac{2}{13}(3^{50} - 1)$

(2) $\frac{1}{26}(3^{49} - 1)$

(3) $\frac{1}{13}(3^{50} - 1)$

(4) $\frac{1}{26}(3^{50} - 1)$

Sol.

4

$$\frac{ar + ar^2 + ar^3}{ar^5 + ar^6 + ar^7} = \frac{3}{243}$$

$$\frac{1+r+r^2}{r^4(1+r+r^2)} = \frac{1}{81}$$

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$$\boxed{r = 3}$$

$$a(3+9+27) = 3$$

$$a = \frac{3}{39} = \frac{1}{13}$$

$$S_{50} = a \left(\frac{r^{50} - 1}{r - 1} \right)$$

$$= \frac{1}{13} \left\{ \frac{3^{50} - 1}{2} \right\} \dots\dots\dots(4)$$

Q.13 If the line $y=mx+c$ is a common tangent to the hyperbola $\frac{x^2}{100} - \frac{y^2}{64} = 1$ and the circle $x^2+y^2=36$, then which one of the following is true?

यदि रेखा $y=mx+c$ अतिपरवलय $\frac{x^2}{100} - \frac{y^2}{64} = 1$ की एक उभयनिष्ठ स्पर्शरेखा है तथा वृत्त $x^2+y^2=36$ है तब निम्न में से कौनसा एक सही है ?

- (1) $4c^2=369$ (2) $c^2=369$ (3) $8m+5=0$ (4) $5m=4$

Sol. 1

$$c = \pm\sqrt{a^2m^2 - b^2}$$

$$c = \pm\sqrt{100m^2 - 64}$$

$$y = mx \pm\sqrt{100m^2 - 64}$$

$$d_{(0,0)} = 6$$

$$\frac{\sqrt{100m^2 - 64}}{\sqrt{m^2 + 1}} = 6$$

$$100m^2 - 64 = 36m^2 + 36$$

$$64m^2 = 100$$

$$m = 10/8$$

$$c^2 = 100 \times \frac{100}{64} - 64 \Rightarrow \frac{(164)(36)}{64} \quad \boxed{4c^2 = 369}$$

Q.14 The area (in sq. units) of the region $A = \{(x, y) : (x - 1)[x] \leq y \leq 2\sqrt{x}, 0 \leq x \leq 2\}$ where $[t]$ denotes the greatest integer function, is:

यदि क्षेत्र $A = \{(x, y) : (x - 1)[x] \leq y \leq 2\sqrt{x}, 0 \leq x \leq 2\}$ का क्षेत्रफल (वर्ग इकाई में), जहां $[t]$ महत्तम पूर्णांक फलन को निरूपित करता है, होगा-

- (1) $\frac{4}{3}\sqrt{2} - \frac{1}{2}$ (2) $\frac{8}{3}\sqrt{2} - \frac{1}{2}$ (3) $\frac{8}{3}\sqrt{2} - 1$ (4) $\frac{4}{3}\sqrt{2} + 1$

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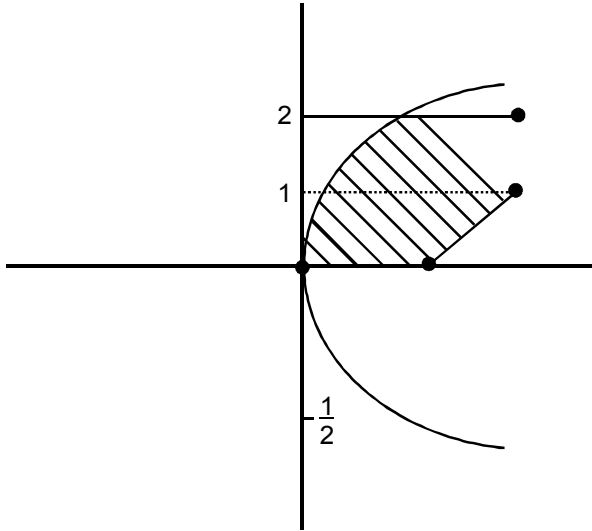
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Sol. 2

$$y = f(x) = (x - 1) [x] = \begin{cases} 0 & 0 \leq x < 1 \\ x - 1 & 1 \leq x < 2 \\ 2(x-1) & x = 2 \end{cases}$$

$$y^2 \leq 4x$$



$$\int_0^1 (2\sqrt{x} - 0) + \int_1^2 (2\sqrt{x} - (x - 1))$$

$$\frac{2}{3} \times 2x^{3/2} \Big|_0^1 + \left(\frac{4}{3} x^{3/2} - \frac{x^2}{2} + x \right) \Big|_1^2$$

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

$$\frac{4}{3} + \frac{8\sqrt{2}}{3} - \frac{4}{3} - \frac{1}{2} = \frac{8\sqrt{2}}{3} - \frac{1}{2}$$

Q.15 If $a+x=b+y=c+z+1$, where a, b, c, x, y, z are non-zero distinct real numbers. then $\begin{vmatrix} x & a+y & x+a \\ y & b+y & y+b \\ z & c+y & z+c \end{vmatrix}$ is equal to:

यदि $a+x=b+y=c+z+1$ है जहाँ a, b, c, x, y, z अशून्य भिन्न-भिन्न वास्तविक संख्यायें हैं। तब $\begin{vmatrix} x & a+y & x+a \\ y & b+y & y+b \\ z & c+y & z+c \end{vmatrix}$ बराबर है—

(1) $y(a-b)$

(2) 0

(3) $y(b-a)$

(4) $y(a-c)$

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Sol. 1

$$\begin{vmatrix} x & a & x+a \\ y & b & y+b \\ z & c & z+c \end{vmatrix} + \begin{vmatrix} x & y & x+a \\ y & y & y+b \\ z & y & z+c \end{vmatrix}$$

$$\begin{vmatrix} x & y & a \\ y & y & b \\ z & y & c \end{vmatrix} \Rightarrow y \begin{vmatrix} x & 1 & a \\ y & 1 & b \\ z & 1 & c \end{vmatrix}$$

$$y \begin{vmatrix} x & 1 & a \\ y-x & 0 & b-a \\ z-x & 0 & c-a \end{vmatrix}$$

$$y \times 0 - 1 \{ (y-x)(c-a) - (b-a)(z-x) \} + a \times 0$$

$$y [bz - bx - az + ax - (cy - ay - cx + ax)]$$

$$y [bz - bx - az - cy + ay + cx]$$

$$y [b(z-x) + a(y-z) + c(x-y)]$$

$$y [b\{a-c-1\} + a\{c-b+1\} + c\{b-a\}]$$

$$y [ab - bc - b + ac - ab + a + bc - ac]$$

$$\boxed{y(a-b)}$$

Q.16 If for some $\alpha \in \mathbb{R}$, the lines $L_1 : \frac{x+1}{2} = \frac{y-2}{-1} = \frac{z-1}{1}$ and $L_2 : \frac{x+2}{\alpha} = \frac{y+1}{5-\alpha} = \frac{z+1}{1}$ are coplanar, then the line L_2 passes through the point:

यदि कोई $\alpha \in \mathbb{R}$ के लिये रेखाएँ $L_1 : \frac{x+1}{2} = \frac{y-2}{-1} = \frac{z-1}{1}$ तथा $L_2 : \frac{x+2}{\alpha} = \frac{y+1}{5-\alpha} = \frac{z+1}{1}$ समतलिय है तब रेखा L_2 निम्न

बिन्दु से गुजरती है-

- (1) (2, -10, -2) (2) (10, -2, -2) (3) (10, 2, 2) (4) (-2, 10, 2)

Sol. 1

$$A (-1, 2, 1), B(-2, -1, -1)$$

$$[\overline{AB} \quad \overline{b_1} \quad \overline{b_2}] = 0$$

$$\begin{vmatrix} -1 & -3 & -2 \\ 2 & -1 & 1 \\ \alpha & 5-\alpha & 1 \end{vmatrix} = 0$$

$$-1(-1+\alpha-5) + 3(2-\alpha) - 2(10-2\alpha+\alpha) = 0$$

$$6-\alpha + 6-3\alpha + 2\alpha - 20 = 0$$

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$$-8 - 2\alpha = 0$$

$$\boxed{\alpha = -4}$$

$$L_2 : \frac{x+2}{-4} = \frac{y+1}{9} = \frac{z+1}{1}$$

any point on L_2 is

$$(-4\lambda - 2, 9\lambda - 1, \lambda - 1) = A$$

Q.17 The value of $\left(\frac{-1 + i\sqrt{3}}{1 - i}\right)^{30}$ is:

$$\left(\frac{-1 + i\sqrt{3}}{1 - i}\right)^{30} \text{ का मान है—}$$

(1) $2^{15}i$

(2) -2^{15}

(3) $-2^{15}i$

(4) 6^5

Sol. 3

$$\left(\frac{-1 + i\sqrt{3}}{1 - i}\right)^{30} \Rightarrow \left[\left(\frac{-1 + i\sqrt{3}}{2}\right)(1 + i)\right]^{30}$$

$$\omega^{30} (1 + i)^{30} = 2^{15} (-i)$$

Q.18 Let $y=y(x)$ be the solution of the differential equation $\cos x \frac{dy}{dx} + 2y \sin x = \sin 2x$, $x \in \left(0, \frac{\pi}{2}\right)$.

If $y(\pi/3) = 0$, then $y(\pi/4)$ is equal to:

माना $y=y(x)$ अवकल समीकरण $\cos x \frac{dy}{dx} + 2y \sin x = \sin 2x$, $x \in \left(0, \frac{\pi}{2}\right)$ का हल है यदि $y(\pi/3) = 0$ है, तब $y(\pi/4)$ बराबर है—

(1) $2 + \sqrt{2}$

(2) $\sqrt{2} - 2$

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

(4) $2 - \sqrt{2}$

Sol. 2

$$\frac{dy}{dx} + (2 \tan x)y = 2 \sin x$$

$$\text{I.F.} = e^{2 \int \tan x dx} = \sec^2 x$$

$$y(\sec^2 x) = 2 \int \frac{\sin x}{\cos^2 x} dx$$

$$= 2 \int \sec x \tan x dx = 2 \sec x + c$$

$$y\left(\frac{\pi}{3}\right) = 0$$

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$$0 = 2 \times 2 + c = C = -4$$

$$y(\sec^2 x) = 2\sec x - 4$$

$$x = \pi/4$$

$$2y = 2\sqrt{2} - 4$$

$$y = \boxed{\sqrt{2} - 2}$$

Q.19 If the system of linear equations

$$x+y+3z=0$$

$$x+3y+k^2z=0$$

$$3x+y+3z=0$$

has a non-zero solution (x,y,z) for some $k \in \mathbb{R}$, then $x + \left(\frac{y}{z}\right)$ is equal to:

यदि रेखीय समीकरण निकाय

$$x+y+3z=0$$

$$x+3y+k^2z=0$$

$$3x+y+3z=0$$

कोई $k \in \mathbb{R}$ के लिए एक अशून्य हल (x,y,z) रखते हैं, तब $x + \left(\frac{y}{z}\right)$ बराबर है-

(1) -9

(2) 9

(3) -3

(4) 3

Sol.

3

$$\begin{vmatrix} 1 & 1 & 3 \\ 1 & 3 & k^2 \\ 3 & 1 & 3 \end{vmatrix} = 0$$

$$(9-k^2)-(3-3k^2) + 3(-8)=0$$

$$9-k^2-3+3k^2-24=0$$

$$2k^2-18=0$$

$$k^2=9$$

$$\boxed{K=3,-3}$$

$$x+y+3z=0$$

$$x+3y+9z=0$$

$$2y+6z=0$$

$$\boxed{y = -3z}$$

$$\boxed{y/z = -3}$$

$$2x=0$$

$$\boxed{x = 0}$$

$$x + \left(\frac{y}{z}\right) = -3$$

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Q.20 Which of the following points lies on the tangent to the curve $x^4e^y + 2\sqrt{y+1} = 3$ at the point (1,0)?

निम्न में से कौनसा बिन्दु, बिन्दु (1,0) पर वक्र $x^4e^y + 2\sqrt{y+1} = 3$ की स्पर्शरेखा पर स्थित है ?

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

Sol. 3

$$4x^3e^y + x^4e^y y' + \frac{2y'}{2\sqrt{y+1}} = 0$$

at (1,0)

$$4 + y' + \frac{2y'}{2} = 0$$

$$2y' = -4 \Rightarrow y' = -2$$

E.O.T. :

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

$$\boxed{2x + y = 2}$$

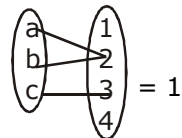
Q.21 Let $A = \{a, b, c\}$ and $B = \{1, 2, 3, 4\}$. Then the number of elements in the set $C = \{f : A \rightarrow B \mid 2 \in f(A) \text{ and } f \text{ is not one-one}\}$ is _____

माना $A = \{a, b, c\}$ तथा $B = \{1, 2, 3, 4\}$ है। तब समुच्च $C = \{f : A \rightarrow B \mid 2 \in f(A) \text{ तथा } f \text{ एकैकी नहीं है, में अवयवों की संख्या होगी—}$

Sol. 19

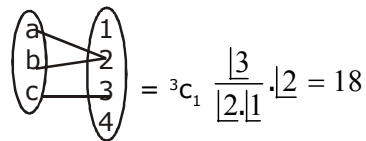
case - I

set B only have '2'



case - II

set B have more element with 2



total $18 + 1 = 19$

Q.22 The coefficient of x^4 in the expansion of $(1+x+x^2+x^3)^6$ in powers of x , is _____

x की धातो में $(1+x+x^2+x^3)^6$ के विस्तार में x^4 का गुणांक है—

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Sol. 120

$$(1+x)^6(1+x^2)^6$$

$${}^{6}C_r x^r \quad {}^{6}C_s x^{2s}$$

$${}^{6}C_r {}^{6}C_s x^{r+2s}$$

r	s
0	2
4	0
2	1

$$\Rightarrow {}^{6}C_0 {}^{6}C_2 + {}^{6}C_4 {}^{6}C_0 + {}^{6}C_2 {}^{6}C_1$$

$$\Rightarrow 15+15+15 \times 6$$

$$\Rightarrow 120$$

Q.23 Let the vectors $\vec{a}, \vec{b}, \vec{c}$ be such that $|\vec{a}| = 2, |\vec{b}| = 4$ and $|\vec{c}| = 4$. If the projection of \vec{b} on \vec{a} is equal to the projection of \vec{c} on \vec{a} and \vec{b} is perpendicular to \vec{c} , then the value of $|\vec{a} + \vec{b} - \vec{c}|$ is _____

माना सदिश $\vec{a}, \vec{b}, \vec{c}$ इस प्रकार है कि $|\vec{a}| = 2, |\vec{b}| = 4$ तथा $|\vec{c}| = 4$ है। यदि \vec{b} का \vec{a} पर प्रक्षेप, \vec{c} का \vec{a} पर प्रक्षेप के बराबर है तथा \vec{b}, \vec{c} के लम्बवत् है तब $|\vec{a} + \vec{b} - \vec{c}|$ का मान है—

Sol. 6

$$\frac{\vec{b} \cdot \vec{a}}{2} = \frac{\vec{c} \cdot \vec{a}}{2} \quad \boxed{\vec{b} \cdot \vec{a} = \vec{c} \cdot \vec{a}}$$

$$\boxed{\vec{b} \cdot \vec{c} = 0}$$

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

$$= \sqrt{4 + 16 + 16}$$

$$= 6$$

Q.24 If the lines $x+y=a$ and $x-y=b$ touch the curve $y=x^2-3x+2$ at the points where the curve intersects the x-axis, then $\frac{a}{b}$ is equal to _____

यदि रेखाएं $x+y=a$ तथा $x-y=b$ वक्र $y=x^2-3x+2$ को किसी बिन्दु पर स्पर्श करती है जहां वक्र x-अक्ष को प्रतिच्छेद करता है तब

$\frac{a}{b}$ बराबर है—

Sol. 0.5

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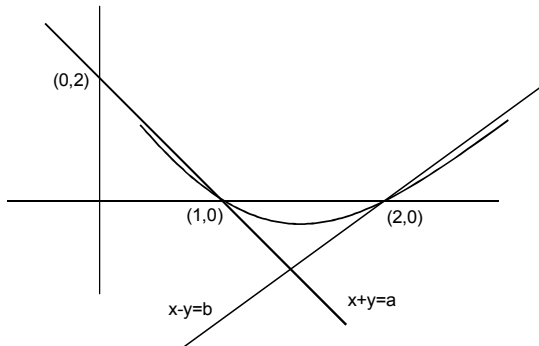
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$$y - 0 = -1(x - 1)$$

$$x + y = 1 \Rightarrow a = 1$$

$$y - 0 = x - 2$$

$$x - y = 2 = b = 2$$

$$\boxed{\frac{a}{b} = \frac{1}{2}}$$

Q.25 In a bombing attack, there is 50% chance that a bomb will hit the target. At least two independent hits are required to destroy the target completely. Then the minimum number of bombs, that must be dropped to ensure that there is at least 99% chance of completely destroying the target, is _____

बमबारी हमले में, 50% संभावना है कि एक बम लक्ष्य को मार देगा। लक्ष्य को पूरी तरह से नष्ट करने के लिए तो स्वतंत्र मार (hit) की आवश्यकता होती है। तब बमों की न्यूनतम संख्या, यह सुनिश्चित करने के लिए गिराई जानी चाहिए कि लक्ष्य को पूरी तरह से नष्ट करने के लिए कम से कम 99% संभावना है, होगी—

Sol. 11

Let 'n' is total no. of bombs being dropped at least 2 bombs should hit

$$\Rightarrow \text{prob} \geq 0.99$$

$$P(x \geq 2) \geq 0.99$$

$$1 - P(x < 2) \geq 0.99$$

$$1 - (P(x=0) + P(x=1)) \geq 0.99$$

$$1 - [{}^nC_0 (p)^0 q^n + {}^nC_1 (p)^1 (q)^{n-1}] \geq 0.99$$

$$1 - [q^n + npq^{n-1}] \geq 0.99$$

$$1 - \left[\frac{1}{2^n} + \frac{1}{2} \times \frac{1}{2^{n-1}} \right] \geq 0.99$$

$$1 - \frac{1}{2^n} (n+1) \geq 0.99$$

$$0.01 \geq \frac{1}{2^n} (n+1)$$

$$2^n \geq 100 + 100n$$

$$n \geq 11$$

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