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Solution of Set A

Que 61 The Function $f: \mathbb{R} \rightarrow [-\frac{1}{2}, \frac{1}{2}]$

Sol. $f(x) = \frac{x}{1+x^2}$ Ans 2 Surjective but Not Injective.

diff.

$$f'(x) = \frac{1(1+x^2) - x(0+2x)}{(1+x^2)^2}$$

$$f'(x) = \frac{1+x^2 - 2x^2}{(1+x^2)^2}$$

$$f'(x) = \frac{1-x^2}{(1+x^2)^2} \rightarrow (1-x)(1+x)$$

+ve

for Short Tricks Batch of Advanced read last Page 27 Thanks

Wavy Curve of $f'(x)$

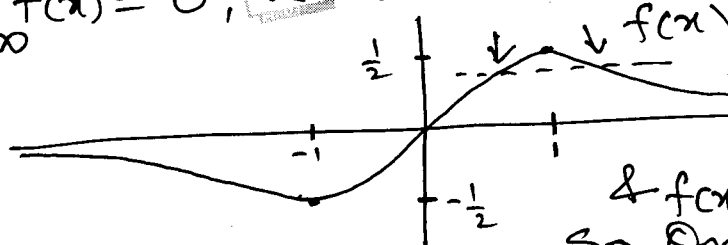
ये right lower आया ✱



about $f(x)$

$$f(-1) = \frac{-1}{2}; f(1) = \frac{1}{2}$$

$\lim_{x \rightarrow \pm\infty} f(x) = 0$; Zero because lower degree is more.



Horizontal line cuts at 2 points

it is Many One & $f(x) \in [-\frac{1}{2}, \frac{1}{2}]$ not injective
 So Onto Ans 2. P.T.O.

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Solution of Set A

Q.62 If, for a positive integer n , ---

Sol.

$$\begin{aligned} x(x+1) &= x^2 + 1x + 0 \quad \begin{matrix} \leftarrow 0 \cdot 1 \\ \leftarrow 1 \cdot 2 \\ \leftarrow 2 \cdot 3 \\ \leftarrow 3 \cdot 4 \end{matrix} \\ (x+1)(x+2) &= x^2 + 3x + 2 \\ (x+2)(x+3) &= x^2 + 5x + 6 \\ (x+3)(x+4) &= x^2 + 7x + 12 \\ (x+4)(x+5) &= x^2 + 9x + 20 \end{aligned}$$

Sum. $(x+(n-1))(x+n) = x^2 + (2n-1)x + (n-1)(n)$

$$10n = n \cdot x^2 + n^2 \cdot x + \sum_{r=1}^n (r-1)(r) + \sum_{r=1}^n (r^2 - r)$$

$$10n = nx^2 + n^2x + \sum n^2 - \sum n$$

$$\div \text{by } n \quad 10 = x^2 + nx + \frac{n(n+1)(2n+1)}{6} - \frac{n(n+1)}{2}$$

$$10 = x^2 + nx + \frac{(n+1)}{6} [2n+1 - 3]$$

$$10 = x^2 + nx + \frac{(n+1) \cdot 2 \cdot (n-1)}{6}$$

$$10 = x^2 + nx + \frac{(n+1)(n-1)}{3} \quad \text{P.T.O.}$$

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Solution of set A

Q. 62 Part B

$$10 = x^2 + nx + \frac{(n+1)(n-1)}{3}$$

$$30 = 3x^2 + 3nx + n^2 - 1$$

$$0 = 3x^2 + 3nx + n^2 - 31 \quad \left\{ \begin{array}{l} \alpha \\ \alpha + 1 = \beta \end{array} \right.$$

So diff of roots = 1

$$|\alpha - \beta| = 1$$

$$\sqrt{(\alpha + \beta)^2 - 4\alpha\beta} = 1$$

$$\sqrt{\left(\frac{-3n}{3}\right)^2 - 4\left(\frac{n^2-31}{3}\right)} = 1$$

$$n^2 - \frac{4(n^2-31)}{3} = 1$$

$$3n^2 - 4n^2 + 4 \cdot 31 = 3$$

$$-n^2 = 3 - 124$$

$$-n^2 = -121$$

$$n = 11$$

So. Ans '3'

P.T.O.

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Solution of Set A.

Q 63 let ω be a complex Num.

Sol.

$$\begin{vmatrix} 1 & 1 & 1 \\ 1 & -\omega^2 - 1 & \omega^2 \\ 1 & \omega^2 & \omega^7 \end{vmatrix} = 3K$$

$C_1 \rightarrow C_1 + C_2 + C_3$ & $-\omega^2 - 1 = \omega$ will be $\omega^6 \cdot \omega = \omega$

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

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

Expanding C_1

$$3 \begin{vmatrix} \omega & \omega^2 \\ \omega^2 & \omega \end{vmatrix} = 3K$$

$$3 \cdot (\omega^2 - \omega^4) = 3K$$

$$\omega^2 - \omega = K$$

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

$$-i\sqrt{3} = K$$

$$-Z = K \text{ P.T.O.}$$

Given
 $2\omega + 1 = i\sqrt{3} = Z$
 $2\omega = -1 + i\sqrt{3}$
 $\omega = \frac{-1 + i\sqrt{3}}{2}$

$$1 + x + x^2 = 0$$

$$x = \frac{-1 \pm \sqrt{1-4}}{2}$$

$$x = \frac{-1 \pm i\sqrt{3}}{2}$$

$$\text{So } \omega^2 = \frac{-1 - i\sqrt{3}}{2}$$

SO
Ans '4'

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Solution of set A

Q.64 If $A = \begin{bmatrix} 2 & -3 \\ -4 & 1 \end{bmatrix}$

Sol.

$$A^2 = \begin{bmatrix} 2 & -3 \\ -4 & 1 \end{bmatrix} \begin{bmatrix} 2 & -3 \\ -4 & 1 \end{bmatrix}$$

Prod. rule पीछे से आगे पे लेटाओ

$$= \begin{bmatrix} 4+12 & -6-3 \\ -8-4 & 12+1 \end{bmatrix}$$

$$A^2 = \begin{bmatrix} 16 & -9 \\ -12 & 13 \end{bmatrix} \quad \left\{ \begin{array}{l} 3A^2 = \begin{bmatrix} 48 & -27 \\ -36 & 39 \end{bmatrix} \end{array} \right.$$

$$12A = \begin{bmatrix} 24 & -36 \\ -48 & 12 \end{bmatrix}$$

$$B = 3A^2 + 12A = \begin{bmatrix} 72 & -63 \\ -84 & 51 \end{bmatrix}$$

$$\text{adj } B = \begin{bmatrix} 51 & 63 \\ 84 & 72 \end{bmatrix} \quad \text{So Ans '1'}$$

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Solution of Set A.

Q. 65. If S is the set of distinct values of 'b'

Sol.

$$D = 0$$

$$\begin{vmatrix} 1 & 1 & 1 \\ 1 & a & 1 \\ a & b & 1 \end{vmatrix} = 0$$

$$1(a-b) - 1(1-a) + 1(b-a^2) = 0$$

$$a - b - 1 + a + b - a^2 = 0$$

is not depend on 'b'

$$0 = a^2 - 2a + 1$$

$$0 = (a-1)^2 \quad \& \text{ depend on 'a'}$$

$$a = 1$$

Now eq $x + y + z = 1$ — ①

$x + y + z = 1$ — ②

$x + by + z = 0$

Plane 1 & 2 are same other plane will be parallel (No Sol.) only if $b=1$
 So solution set of S is singleton.

Ans '3'

P.T.O.

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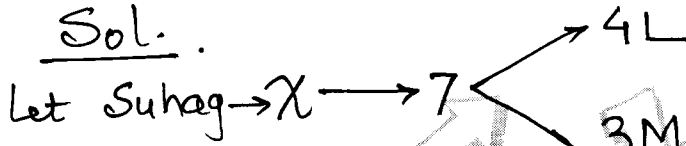
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Solution of Set A.

Q.66 Aman X has 7 friends, 4 of them ---

Sol.



In party 3L & 3M also 3 friends each of X & Y

	X	Y
R ₁ →	L _x L _x L _x L _x	L _y L _y L _y
R ₂ →	M _x M _x M _x	M _y M _y M _y M _y

Possibilities

$$\begin{array}{c|c} 0 & 3 \\ \hline 3 & 0 \end{array}$$

$$\begin{array}{c|c} 1 & 2 \\ \hline 2 & 1 \end{array}$$

$$\begin{array}{c|c} 2 & 1 \\ \hline 1 & 2 \end{array}$$

$$\begin{array}{c|c} 3 & 0 \\ \hline 0 & 3 \end{array}$$

$$\begin{aligned}
 & {}^4C_0 \cdot {}^3C_3 \cdot {}^3C_3 \cdot {}^4C_0 + {}^4C_1 \cdot {}^3C_2 \cdot {}^3C_2 \cdot {}^4C_1 + {}^4C_2 \cdot {}^3C_1 \cdot {}^3C_1 \cdot {}^4C_2 + {}^4C_3 \cdot {}^3C_0 \cdot {}^3C_0 \cdot {}^4C_3 \\
 & + 4 \cdot 3 \cdot 3 \cdot 4 + 6 \cdot 3 \cdot 3 \cdot 6 + 4 \cdot 1 \cdot 1 \cdot 4 \\
 & + 144 + 324 + 16 = 485
 \end{aligned}$$

Ans 4
P.T.O.

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Solution of Set A.

Q. 67. The value of.

Sol. ${}^{21}C_1 + {}^{21}C_2 + {}^{21}C_3 + {}^{21}C_4 + \dots + {}^{21}C_{10} = \star$

$${}^{21}C_0 + {}^{21}C_1 + {}^{21}C_2 + {}^{21}C_3 + \dots + {}^{21}C_{10} + {}^{21}C_{11} + {}^{21}C_{12} + \dots + {}^{21}C_{19} + {}^{21}C_{20} + {}^{21}C_{21} = 2^{21}$$

So we can say

$$1 + \star + 1 + \star = 2^{21}$$

$$2(1 + \star) = 2^{21}$$

$$1 + \star = 2^{20}$$

$$\star = 2^{20} - 1$$

$$\# = {}^{10}C_1 + {}^{10}C_2 + \dots + {}^{10}C_{10} = 2^{10} - 1$$

$$\text{So Ans } \star - \# = (2^{20} - 1) - (2^{10} - 1) = 2^{20} - 2^{10}$$

Ans '3'

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Solution of Set A.

Q. 68. For any three positive real num.

Sol.

$$9(25a^2 + b^2) + 25(c^2 - 3ac) = 15b(3a + c)$$

$$225a^2 + 25c^2 + 9b^2 - 75ac - 45ab - 15bc = 0.$$

$$(15a)^2 + (3b)^2 + (5c)^2 - \frac{150ac}{2} - \frac{90ab}{2} - \frac{90bc}{2} = 0.$$

$$\star^2 + \#^2 + \cup^2 - \star\# - \# \cup - \star \cup = 0$$

$$(\star - \#)^2 + (\# - \cup)^2 + (\star - \cup)^2 = 0$$

$$\text{So } \star = \# = \cup$$

$$15a = 3b = 5c$$

$$\div 15 \quad a = \frac{b}{5} = \frac{c}{3} = \heartsuit$$

$$a = \heartsuit \quad \left\{ \begin{array}{l} b = 5\heartsuit \\ c = 3\heartsuit \end{array} \right.$$

So a, c, b are in A.P.

Ans '1'

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Solution of Set A.

Q. 69: let $a, b, c \in \mathbb{R}$; If $f(x) = ax^2 + bx + c$ -
 $a + b + c = 3$ Given

Sol. $f(x+y) = f(x) + f(y) + xy \quad \forall x, y \in \mathbb{R}$
 $f(x+y) - f(x) = f(y) + xy$

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h} = \lim_{h \rightarrow 0} \frac{f(h) + xh}{h}$$

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(h)}{h} + x.$$

We can use short Trick of partial diff. in given condition directly.

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(0+h) - f(0)}{h} + x. \quad \text{it must be } f(0) = 0 = c$$

$$f'(x) = f'(0) + x.$$

$$f'(x) = b + x.$$

integrate

$$f(x) = bx + \frac{x^2}{2} + \star \quad \rightarrow \star = c = 0$$

$$f(x) = \frac{1}{2}x^2 + bx + 0 \quad a = \frac{1}{2}$$

Given $a + b + c = 3$
 $\frac{1}{2} + b + 0 = 3 \rightarrow b = \frac{5}{2}$

$$\sum_{n=1}^{10} f(n) = \sum_{n=1}^{10} \left(\frac{1}{2}n^2 + \frac{5}{2}n \right) = \frac{1}{2} \left(\frac{10 \cdot 11 \cdot 21}{6} \right) + \frac{5}{2} \left(\frac{10 \cdot 11}{2} \right)$$

$$= \frac{1}{2} [10 \cdot 11] \left[\frac{7}{2} + \frac{5}{2} \right] = 10 \cdot 11 \cdot 3 = 330$$

Ans '4' P.T.O.

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SET (A)

$$Q. 70 \Rightarrow \lim_{x \rightarrow \pi/2} \frac{\cot x - \cos x}{(\pi - 2x)^3}$$

$$\Rightarrow \lim_{x \rightarrow \pi/2} \frac{\cos x (1 - \sin x)}{(\pi - 2x)^3 \sin x} \xrightarrow{h \rightarrow 0} \frac{\cos(\pi/2 + h) (1 - \sin(\pi/2 + h))}{(\pi - \pi - 2h) \sin(\pi/2 + h)}$$

$$\Rightarrow \lim_{h \rightarrow 0} \frac{+\sinh (1 - \cosh)}{+8h^3 (\cosh)} \left. \begin{array}{l} \lim_{h \rightarrow 0} \frac{\sinh}{h} = 1 \\ \lim_{h \rightarrow 0} \frac{1 - \cosh}{h^2} = \frac{1}{2} \end{array} \right\}$$

$$\Rightarrow \lim_{h \rightarrow 0} \frac{(1) \sinh}{16 h} = \frac{1}{16} \cdot \text{Ans. (1)}$$

Teko

P.T.O.

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Solution set A

Q.71. If for $x \in (0, \frac{1}{4})$ the derivative - - -

Sol.

$$\frac{d}{dx} \tan^{-1} \left(\frac{6\sqrt{x} \cdot x}{1-9x^3} \right) = \sqrt{x} \cdot g(x)$$

let

$$3x\sqrt{x} = \tan \theta \quad \rightarrow \theta = \tan^{-1} 3x\sqrt{x}$$

$$\frac{d}{dx} \tan^{-1} \left(\frac{2 \tan \theta}{1 - \tan^2 \theta} \right)$$

Here

$$\tan^2 \theta < 1$$

$$\frac{d}{dx} \tan^{-1} (\tan 2\theta)$$

$$\text{as } x \in (0, \frac{1}{4})$$

$$\frac{d}{dx} (2\theta)$$

$$2 \frac{d}{dx} (\tan^{-1} 3x\sqrt{x}) = 2 \left(\frac{1}{1+9x^3} \right) \frac{d}{dx} (3x\sqrt{x})$$

$$= 2 \times \frac{1}{1+9x^3} \times 3 \left(\frac{3}{2} \cdot x^{1/2} \right) \quad g(x)$$

$$= \frac{9\sqrt{x}}{1+9x^3} = \sqrt{x} \cdot \frac{9}{1+9x^3}$$

So Ans '4' P.T.O.

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Solution of Set A

Q.72 The normal to the curve — — —

Sol cut at y axis $x_1 = 0$

$$y_1(0-2)(0-3) = 0+6$$

$$y_1 = 1$$

$$(0, 1)$$

$$y = \frac{x+6}{x^2-5x+6}$$

$$m_t = \frac{dy}{dx} = \frac{1(x^2-5x+6) - (x+6)(2x-5)}{(x^2-5x+6)^2}$$

$$m_t \underset{x \rightarrow 0}{=} \frac{6 - (6)(-5)}{6^2}$$

$$= \frac{6(1+5)}{6^2} = 1$$

$$m_n = -1$$

Eq of Normal at (0,1) $(y-1) = -1(x-0)$

$$y-1 = -x$$

$$x+y = 1$$

So Ans 1 $(\frac{1}{2}, \frac{1}{2})$

P.T.O.