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Solution of Set A

Que 61 The Function $f : R \to \left[-\frac{1}{2}, \frac{1}{2}\right]$

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

diff.

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

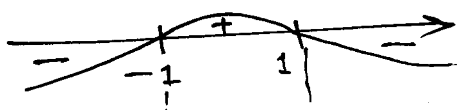
$$f'(x) = \frac{1+x^2-2x^2}{(1+x^2)^2}$$

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

$1-x^2 \to (1-x)(1+x)$; $(1+x^2)^2 \to +ve$

for Short Tricks Batch of Advanced read last Page 27 Thanks

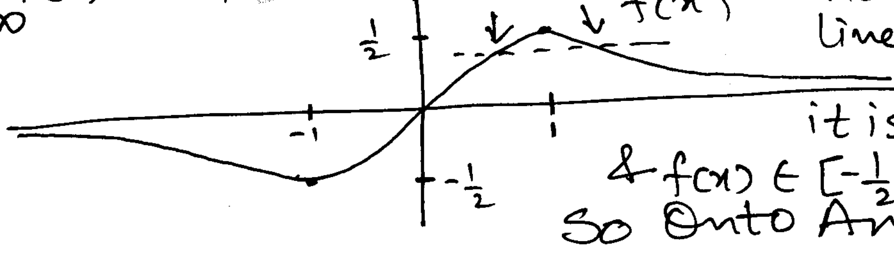
Wavy Curve of $f'(x)$ — र्त right lower से आया ☆



about $f(x)$

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

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



Horizontal line cuts at 2 points

it is Many One not injective

& $f(x) \in \left[-\frac{1}{2}, \frac{1}{2}\right]$

So Onto Ans 2. P.T.O.

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Solution of Set A

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

Sol.

$$x(x+1) = x^2 + 1x + 0 \quad (0\cdot 1)$$
$$(x+1)(x+2) = x^2 + 3x + 2 \quad (1\cdot 2)$$
$$(x+2)(x+3) = x^2 + 5x + 6 \quad (2\cdot 3)$$
$$(x+3)(x+4) = x^2 + 7x + 12 \quad (3\cdot 4)$$
$$(x+4)(x+5) = x^2 + 9x + 20$$
$$\vdots$$
$$(x+(n-1))(x+n) = x^2 + (2n-1)x + (n-1)(n)$$

Sum.

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

÷ by n

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

P.T.O.

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Solution of Set A

Q. 62 For Part B

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

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

$$0 = 3x^2 + 3nx + n^2 - 31 \quad < \begin{matrix} \alpha \\ \alpha + 1 = \beta \end{matrix}$$

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.

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

ω^7 will be $\omega^6.\omega = \omega$

$C_1 \to C_1 + C_2 + C_3$ & $-\omega^2 - 1 = \omega$

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

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

Expan C_1

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

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

$\omega^2 - \omega = K$

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

$-i\sqrt{3} = K$

$-Z = K$ P.T.O.

Given

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

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

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

$1+x+x^2=0$

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

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

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~~ आगे पे लेटाओ

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

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

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

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

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

P.T.O.

Solution of Set A.

Q.65. If S is the set of distinct value 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'

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

$$0 = (a-1)^2$$ & 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.

Solution of Set A.

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

Sol.

Let Suhag → X → 7 → 4L, 3M

& Suhagan → Y → 7 → 3L, 4M

No common friend

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

	X	Y
R_1 →	$L_x\ L_x\ L_x\ L_x$ (II)	(I) $L_y\ L_y\ L_y$
R_2 →	$M_x\ M_x\ M_x$ (III)	(IV) $M_y\ M_y\ M_y\ M_y$

Possibilities

0 | 3	1 | 2	2 | 1	3 | 0
3 | 0	2 | 1	1 | 2	0 | 3

$${}^4C_0 \cdot {}^3C_3 \cdot {}^3C_3 \cdot {}^4C_0 + {}^4C_1\,{}^3C_2\,{}^3C_2\,{}^4C_1 + {}^4C_2\,{}^3C_1\,{}^3C_1\,{}^4C_2 + {}^4C_3\,{}^3C_0\,{}^3C_0\,{}^4C_3$$

$$1 + 4\cdot3\cdot3\cdot4 + 6\cdot3\cdot3\cdot6 + 4\cdot1\cdot1\cdot4$$

$$1 + 144 + 324 + 16 = 485$$ Ans '4'

P.T.O.

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Solution of Set A.

Q. 67. The value of.

Sol.

$${}^{21}C_1 + {}^{21}C_2 + {}^{21}C_3 + {}^{21}C_4 + \cdots + {}^{21}C_{10} = ☆$$

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

So we can say

$$1 + ☆ + 1 + ☆ = 2^{21}$$

$$2(1 + ☆) = 2^{21}$$

$$1 + ☆ = 2^{20}$$

$$☆ = 2^{20} - 1$$

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

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

Ans '3'

P.T.O.

Solution of Set A.

Q. 68. for any thre positive real num.

Sol.

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

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

$$(15a)^2+(3b)^2+(5c)^2-\frac{150ac}{2}-\frac{90ab}{2}-\frac{30bc}{2}=0.$$

$$☆^2+\#^2+♡^2-☆\#-\#♡-☆♡=0$$

$$(☆-\#)^2+(\#-♡)^2+(☆-♡)^2=0$$

So $☆=\#=♡$

$15a=3b=5c$

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

$a=♡\}\ b=5♡\{\ c=3♡$

So a, c, b (or) b, c, a are in AP.

Ans '1'

P.T.O.

Solution of Set A.

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

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

$f(x+y) - f(x) = f(y) + xy$

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

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

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

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

it must be $f(0) = 0 = c$

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

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

$f(x) = ax^2+bx$.
$f'(x) = 2ax+b$
$f'(0) = b$

integrate

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

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

Given $a+b+c = 3$

$\frac{1}{2} + b + 0 = 3 \longrightarrow b = \frac{5}{2}$

$$\sum_{n=1}^{10} f(n) = \sum_{n=1}^{10}\left(\frac{1}{2}n^2 + \frac{5}{2}n\right) = \frac{1}{2}\left(\frac{10.11.21}{6}\right) + \frac{5}{2}\left(\frac{10.11}{2}\right)$$

$$= \frac{1}{2}[10.11]\left[\frac{7}{2}+\frac{5}{2}\right] = 10.11.3 = 330$$

Ans '4' P.T.O.

SET (A)

Q.70 ⇒ $\lim_{x \to \pi/2} \dfrac{\cot x - \cos x}{(\pi - 2x)^3}$

$\Rightarrow \lim_{x \to \pi/2} \dfrac{\cos x (1 - \sin x)}{(\pi - 2x)^3 \sin x} \Rightarrow \lim_{h \to 0} \dfrac{\cos(\pi/2 + h)\,(1 - \sin(\pi/2 + h))}{(\pi - \pi - 2h)\sin(\pi/2 + h)}$

$\Rightarrow \lim_{h \to 0} \dfrac{+\sin h (1 - \cos h)}{+8h^3 (\cos h)}$ $\left\{ \lim_{h \to 0} \dfrac{\sin h}{h} = 1 \quad \lim_{h \to 0} \dfrac{1 - \cos h}{h^2} = \dfrac{1}{2}. \right\}$

$\Rightarrow \lim_{h \to 0} \dfrac{(1) \sin h}{16\, h}$

$= \dfrac{1}{16}$. Ans. (1).

P.T.O.

Solution of set A

Q.71. If for $x \in \left(0, \frac{1}{4}\right)$ 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 $3x\sqrt{x} = \tan\theta$ → $\theta = \tan^{-1}3x\sqrt{x}$.

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

Here $\tan^2\theta < 1$ as $x \in \left(0, \frac{1}{4}\right)$

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

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

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

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

$$= \frac{9\sqrt{x}}{1+9x^3} = \sqrt{x}\cdot\frac{9}{1+9x^3} \quad g(x)$$

So Ans '4' P.T.O.

Solution of Set A

Q72 The normal to the curve ----

Sol cut at y axis $x_1 = 0$

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

$$y_1 = 1$$

$$(0,1)$$

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

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

$x \to 0$

$$m_t = \frac{6-(6)(-5)}{6^2}$$

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

$$m_n = -1$$

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

$$y-1 = -x$$

$$x+y = 1$$

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

P.T.O.