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NMA ASSIGNMENT

1. observed Radius = 12.65 cm
Actual Radius = 12.5 cm

Obeserve area = πr^2.

$A_0 = \pi \times (12.65)^2$.

$\therefore A_0 = 502.75\ cm^2$

Actual area = πr^2

$\cdot A_1 = \pi \times (12.5)^2$.

$\therefore A_1 = 490.874 cm^2$

i) Absolute error = Observed value = actual value

$= 502.725 - 490.874$

$= 11.851\ cm^2$.

ii) Relative error = $\frac{\text{Absolute error}}{\text{Actual value}}$

$= \frac{11.851}{490.874}$

$= 0.02414$.

iii) Percentage error = Relative error $\times 100$

$= 2.414\%$.

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2.(ii) $x_1 = 4$ $\quad y_1 = 0.60206$

$x = 5$ $\quad y = ?$

$x_2 = 6$ $\quad y_2 = 0.7781513$

$$\therefore y = \frac{y_2(x-x_1) + y(x_2 - x_3)}{(x_2 - x_1)}$$

$$= \frac{0.7781513(1) + 0.60206(1)}{2}$$

$\therefore y = 0.6901$

ii) $x_1 = 4.5$ $\quad y_1 = 0.6532125$

$x = 5$ $\quad y = ?$

$x_2 = 5.5$ $\quad y_2 = 0.7403627$

$$\therefore y = \frac{y_2(x-x_1) + y_1(x_2 - x)}{x_2 - x_1}$$

$$= \frac{0.7403627(0.5) + 0.6532125(0.5)}{1}$$

$\therefore y = 0.6901$

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$x^4 - x - 10 = 0$

3. $a = 1.5$ $\quad b = 2$

$\therefore f(a) = f(1.5) = (1.5)^4 - 1.5 - 10$
$= -6.4375$

$f(b) = f(2) = 2^4 - 2 - 10$
$= 4$

$\therefore$ 1st iteration:

$x_1 = \frac{2 \cdot 1.5}{2} = 1.75$

$f(x_1) = f(1.75) = 1.75^4 - 1.75 - 10 = -2.3211$

2nd iteration.

$x_2 = \frac{1.75 + 2}{2} = 1.875.$

$f(x_2) = 1.875^4 - 1.875 - 10 = \underline{\underline{0.4846}}.$

3rd iteration.

$x_3 = \frac{1.75 + 1.875}{2} = 1.8125$

$f(x_3) = f(1.8125) = 1.8125^4 - 1.8125 - 10$
$= -1.0202.$

4th iteration

$x_4 = \frac{1.875 + 1.8125}{2} = 1.84375.$

$f(x_4) = 1.84375^2 - 1.84375 - 10 = \underline{\underline{-0.2871}}$

5^{th} iteration

$$x_5 = \frac{1.875 + 1.84375}{2} = 1.859375$$

$$f(x_5) = 1.859375^4 - 1.859375 - 10$$
$$= \underline{0.093}$$

$\therefore$ root of $x^4 - x - 10 = 0$ is
1.859375

which is approximately 1.86

c. $f(x) = x^3 - x - 1$
$f'(x) = 3x^2 - 1$

x	0	1	2
y	-1	-1	5

$$\therefore x_0 = \frac{1+2}{2} = 1.5$$

$f(x_0) = 0.875$ $\quad f'(x_0) = 5.75$

$$\therefore x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}$$
$$= 1.5 - \frac{0.875}{5.75}$$
$$= \underline{\underline{1.34783}}$$

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$f(x_1) = 0.10068$, $f'(x_1) = 4.44991$

$$x_2 = 1.34783 - \frac{0.10068}{4.44991}$$

$= \cancel{1.3}\ 1.3252$

$\therefore f(x_2) = 0.002502 \quad f'(x_2) = 4.2684$

$$x_3 = 1.3252 - \frac{0.00205}{4.2684}$$

$\therefore x_3 = 1.3247$

$f(x_3) = 0.0000007545$

$f'(x_3) = 4.2645$

$$\therefore x_4 = 1.3247 - \frac{0}{4.2645}$$

$\therefore x_4 = 1.3247$

$\therefore$ Root of $x^3 - x - 1 = 0$ is 1.3247

5. $A^2 = A$

$7A - (1-A)^3 =$ To find

$\therefore 7A - (1+A)^3 = 7A - (I^3 + A^3 + 3A^2 I + 3AI^2)$

$= 7A - I^3 - A^3 - 3A^2 I - 3AI^2$

$= 7A - I^3 - A^2 \cdot A - 3A^2 - 3A$

$= 7A - I - A - \cancel{6A}$

$= 7A - 7A - I$

$\therefore 7A - (I+A)^3 = -I$

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6.) let $A = \begin{bmatrix} 1 & -1 & 2 \\ 4 & 0 & 6 \\ 0 & 1 & -1 \end{bmatrix}$

$\therefore |A| = 1\begin{vmatrix} 0 & 6 \\ 1 & -1 \end{vmatrix} + 1\begin{vmatrix} 4 & 6 \\ 0 & -1 \end{vmatrix} + 2\begin{vmatrix} 4 & 0 \\ 0 & 1 \end{vmatrix}$

$= 1(-6) + 1(-4) + 2(4) = -2.$

$|A| \neq 0$ inverse exist.

co-factor matric $= \begin{bmatrix} -6 & 4 & 4 \\ 1 & -1 & 7 \\ -6 & 2 & 4 \end{bmatrix}$

$\therefore$ Adjoint matrix $= \begin{bmatrix} -6 & 4 & 4 \\ 1 & -1 & 7 \\ -6 & 2 & 4 \end{bmatrix}$

$A^{-1} = \frac{1}{|A|} \times$ Adjoint

$\therefore$

$= -\frac{1}{2}\begin{bmatrix} -6 & 1 & -6 \\ 4 & -1 & 2 \\ 4 & 1 & 4 \end{bmatrix}$

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

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9.) The smallest 3 digit no. that leaves remainder of 2 is 101 and the largest is 998.

$\therefore a = 101 \quad ; \quad l = 998.$

$\therefore t_n = a + (n-1) d,$

$998 = 101 + (n-1) 3.$

$\frac{998 - 101}{3} = n - 1$

$\underline{n = 300.}$

$S_n = \frac{n}{2} (a + l) = \frac{300}{2} (101 + 998)$

$= 164850$

$\therefore$ Sum of all numbers that leave a remainder of 2 when divider by 2 is 164850.

10.) $t_6 = 32.$

$t_8 = 128$

$\therefore t_6 = ar^5$

$32 = ar^5 \quad \text{—— (1)}$

$t_8 = ar^7$

$128 = ar^7 \quad \text{—— (2)}$

Dividing (2) and (1)

$\frac{ar^7}{ar^5} = \frac{128}{32}$

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$\therefore x^2 = 4$
$\therefore \boxed{x = 2}$

11.) Expand $(4+3x)^5 = (3x+4)^5$

$\therefore (a+b)^n = a^n + na^{n-1}b + \frac{n(n-1)}{2!}a^{n-2}b^2 + \frac{n(n-1)(n-2)}{3!}$

$= 243x^5 + 1620x^4 + 4320x^3 + \cancel{5060}\ 5760x^2 + 3840x + 1024$

12. $A = \begin{bmatrix} 2 & -3 & 0 \\ 2 & -5 & 0 \\ 0 & 0 & 3 \end{bmatrix}$

$\lambda^3 - (0)\lambda^2 + (-13)\lambda = (30 + 18 + 0) = 0$
$\therefore \lambda^3 - 13\lambda + 12 = 0$
$\therefore \lambda = 1$ satisfies.

$\therefore$ 1	1	0	-13	12
	$\downarrow$	1	1	-12
	1	1	-12	0

$$A = \cancel{\begin{bmatrix} 2 & -2 \end{bmatrix}}$$

$$\therefore \lambda^2 + \lambda - 12 = 0.$$

$$\lambda^2 + 4\lambda - 3\lambda - 12 = 0.$$

$$(\lambda + 4)(\lambda - 3) = 0.$$

$$\lambda = -4 \text{ or } \lambda = 3.$$

13 $f(x) = x^3 - 7x^2 + 8x - 3.$

$$x_0 = 5$$

$$\therefore f(x) = x^3 - 7x^2 + 8x - 3.$$

$$f(5) = -13$$

$$f'(x) = 3x^2 - 14x + 8.$$

$$f'(5) = 13.$$

$$\therefore x_1 = 5 - \left(\frac{-\cancel{13}^{\,1}}{\cancel{13}}\right)$$

$$= 6$$

$$f(6) = 9$$

$$f'(6) = 32.$$

$$x_2 = 6 - \left(\frac{9}{32}\right)$$

$$\therefore \boxed{x_2 = 5.71875}$$

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14.) $(1-x+x^2)^4$

$\therefore [x^2+(1-x)]^4$

let $1-x = y$

$\therefore [x^2+y]^4$

using binomial theorem

$(a+b)^n = a^n + na^{n-1}b + \frac{n(n-1)}{2}a^{n-2}b^2 + \frac{n(n-1)(n}{3!}$

$\therefore (x^2+y)^4 = (x^2)^4 + 4(x^2)^3 y + \frac{\cancel{4}^2 \times 3}{\cancel{2}}(x^2)(y^2 +$

$\frac{4+\cancel{3}\times\cancel{2}}{\cancel{3}\times\cancel{2}}(x^2)(y^3 - \cdot$

$\therefore [x^2+(1-x)]^4 = x^8 + 4x^6(1-x) + 6x^4(1-x)^2$
$+ 4x^2(1-x)^3$
$+(1-x)^4$

15) $e^{-x} = 3\log(x)$

$\therefore f(x) = 3\log x - e^{-x}$

$a = 1 \qquad b = 2$

$\therefore f(a) = 0.367876.$

$f(b) = 1.944106.$

$\therefore \frac{a+b}{2} = \frac{1+2}{2} = 1.5 = x_1$

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$f(x_1) = 0.993268$

$x_2 = \frac{1 + 1.5}{2} = 1.25.$

$f(x_2) = 3\log(1.25) - e^{-1.25}$

$= 0.372925$

$x_3 = \frac{1 + 1.25}{2} = 1.125$

$f(x_3) = 3\log(1.125) - e^{-1.125}.$

$= \underline{0.02769664}$

$\therefore x^4 = \frac{1 + 1.25}{2} = 1.0625$

$f(x_4) = 3\log(1.0625) - e^{-1.0625}$

$= \underline{\underline{-0.16372}}$