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15/ENG04/011

ENG 382

1.

$$f(x) = e^{-0.5x}(4-x) - 2$$
$$= 4e^{-0.5x} - xe^{-0.5x} - 2$$

$$f'(x) = -2e^{-0.5x} - [x \cdot -0.5e^{-0.5x} + e^{-0.5x}]$$
$$= -2e^{-0.5x} + 0.5xe^{-0.5x} - e^{-0.5x}$$
$$= -2e^{-0.5x} + e^{-0.5x}[0.5x - 1]$$
$$= e^{-0.5x}[-2 + 0.5x - 1]$$
$$= e^{-0.5x}[0.5x - 3]$$
$$= \boxed{0.5xe^{-0.5x} - 3e^{-0.5x}}$$

Newton Raphson method

$$x_{i+1} = x_i - \frac{f(x_i)}{f'(x_i)} \qquad [\text{error} = 1 \times 10^{-9}]$$

$\Rightarrow$ If $x_i = 0.5$

$$= 0.5 - \frac{4e^{-0.5\times0.5} - 0.5e^{-0.5\times0.5} - 2}{0.5\times0.5\times e^{-0.5\times0.5} - 3e^{-0.5\times0.5}}$$

$$= 0.5 - \frac{0.7358027407}{-2.141702153} = 0.8388906061$$

$\Rightarrow$ If $x_i = 0.8388906061$

$$= 0.8388906061 - \frac{4e^{-0.5\times0.8388906061} - 0.8388906061e^{-0.5\times0.8388906061} - 2}{0.5\times0.8388906061\times e^{-0.5\times0.8388906061} - 3\times e^{-0.5\times0.8388906061}}$$

$$= 0.8388906061 - \frac{0.07814929779}{-1.696486032} = 0.8849560003$$

~~error = $\left|\frac{0.8849560003 - 0.5}{0.8849560003}\right| \times 100$~~

~~$= 43.50001584$~~

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$$error_1 = \left| \frac{0.8388906061 - 0.5}{0.8388906061} \right| \times 100 = 40.39747\underline{3}$$

$$error_2 = \left| \frac{0.8849560003 - 0.8388906061}{0.8849560003} \right| \times 100 = 5.205388\underline{0}85$$

$\Rightarrow x_0 = 0.8849560003$

$$x_{1,1} = 0.8849560003 - \frac{1.23657517 \times 10^{-3}}{-1.643060762}$$

$$= 0.88570\underline{8}605$$

$$error_3 = \left| \frac{0.885708605 - 0.8849560003}{0.885708605} \right| \times 100$$

$$= 0.0849720\underline{4}337$$

$\Rightarrow x_1 = 0.885708605$

$$x_{1,1} = 0.885708605 - \frac{3.23521409 \times 10^{-7}}{-1.642200927} = 0.88570\underline{8}802$$

$$error_4 = \left| \frac{0.885708802 - 0.885708605}{0.885708802} \right| \times 100$$

$$= 2.224207\underline{3}19 \times 10^{-5}$$

$\Rightarrow x_1 = 0.885708802$

$$x_{1,1} = 0.885708802 - \frac{7.546 \times 10^{-12}}{-1.642200704} = 0.88570\underline{8}802$$

$$error_5 = \left| \frac{0.885708802 - 0.885708802}{0.885708802} \right| \times 100 = \underline{0}$$

Iteration	x_1
0	0.5
1	0.8388906061
2	0.8849560003
3	0.885708605
4	0.885708802
5	0.885708802

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