15/ENG02/005
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ENG382 Assignment - 2.

(1) $f(x) = e^{-0.5x}(11-x) - 2$

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

Recall: $x_{i+1} = x_i - \frac{f(x_i)}{f'(x_i)} = x_i - \left[\frac{e^{-0.5x}(4-x)-2}{-0.5e^{-0.5x}(4-x) - e^{-0.5x}}\right]$

for $i=0$, $x=0.5$

$x_{i+1} = 0.5 - \left[\frac{e^{-0.5(0.5)}(4-0.5)-2}{-0.5e^{-0.5(0.5)}(4-0.5) - e^{-0.5(0.5)}}\right]$

$= 0.8389$

for $i=1$, $x=0.8389$

$x_{i+1} = 0.8389 - \left[\frac{e^{-0.5(0.8389)}(4-0.8389)-2}{-0.5e^{-0.5(0.8389)}(4-0.8389) - e^{-0.5(0.8389)}}\right]$

$= 0.8850$

for $i=2$, $x=0.8850$

$x_{i+1} = 0.8850 - \left[\frac{e^{-0.5(0.8850)}(4-0.8850)-2}{-0.5e^{-0.5(0.8850)}(4-0.8850) - e^{-0.5(0.8850)}}\right]$

$= 0.8857$

for $i=3$, $x=0.8857$

$x_{i+1} = 0.8857 - \left[\frac{e^{-0.5(0.8857)}(4-0.8857)-2}{-0.5e^{-0.5(0.8857)}(4-0.8857) - e^{-0.5(0.8857)}}\right]$

$= 0.8857$

for $i=4$, $x=0.8857$

for $i=5$, $x=0.8857$

$\%$ error tolerance $= \left|\frac{x_{i+1} - x_i}{x_{i+1}}\right| \times 100$

for $i=0$, $x=0.5$. $\%$ error $= 100\%$

for $i=1$, $x=0.8389$

$\%$ error tolerance $= \left|\frac{0.8389 - 0.5}{0.8389}\right| \times 100$

$= 40.39\%$

for $i=2$, $x = 0.8850$

$$\%\ \text{error}_{\text{tolerance}} = \left|\frac{0.8850 - 0.8889}{0.8850}\right| \times 100$$

$$= 5.28\%$$

for $i=3$, $x = 0.8857$

$$\%\ \text{error}_{\text{tolerance}} = \left|\frac{0.8857 - 0.8850}{0.8857}\right| \times 100$$

$$= 0.079\%$$

for $i=4$, $x = 0.8857$

$$\%\ \text{error tolerance} = \left|\frac{0.8857 - 0.8857}{0.8857}\right| \times 100$$

$$= 0\%$$

for $i=5$, $x = 0.8857$

$$\%\ \text{error tolerance} = \left|\frac{0.8857 - 0.8857}{0.8857}\right| \times 100$$

$$= 0\%$$

i	x_i	% Error
0	0.5	100
1	0.8889	40.89
2	0.8850	5.28
3	0.8857	0.079
4	0.8857	0
5	0.8857	0

(2) $F_D = \frac{0.3V^2}{500+(\ln V)^3} - 0.02V$

$F_D = mg$ $\quad m = 3.5\,kg, \quad g = 9.8\,m/s$

$F_D = 9.8 \times 3.5 = 34.3$

Substitute.

$34.3 = \frac{0.3V^2}{500+(\ln V)^3} - 0.02V$

$0 = \frac{0.3V^2}{500+(\ln V)^3} - 0.02V - 34.3$

$F(V) = \frac{0.3V^2}{500+(\ln V)^3} - 0.02V - 34.3$

$F'(V) = ?$

$\frac{0.3V^2}{500+(\ln V)^3}$

from quotient rule : $\frac{U'V - V'U}{V^2}$

$U = 0.3V^2$

$U' = 0.6V$

$V = 500+(\ln V)^3$

$V' = \frac{3(\ln V)^2}{V}$

$= \frac{0.6V(500+(\ln V)^3) - 0.3V^2\left(3\left(\frac{\ln V^2}{V}\right)\right)}{(500+(\ln V)^3)^2}$

$= \frac{300V + (\ln V)^3 0.6V - 0.9V(\ln V)^2}{500^2 + \ln V^6}$

$F'(V) = \frac{300V + \ln V^3(0.6V) - 0.9V(\ln V)^2}{500^2 + \ln V^6} - 0.02$

$x_{i+1} = x_i - \frac{f(V)}{F'(V)}$

$= x_i - \frac{\frac{0.3V^2}{500+(\ln V)^3} - 0.02V - 34.3}{\frac{300V + \ln V^3(0.6V) - 0.9V(\ln V)^2}{500^2 + \ln V^6} - 0.02}$