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15/ENG04/040
ELECT/ELECT ENGR

1) $f(x) = 8^{-0.5x}(4-x) - 2$

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

$f(x_i) = 8^{-0.5x_i}(4-x_i) - 2$

$f'(x_i) =$

$u = 8^{-0.5x}$; $v = 4-x$

$du = -0.5\,8^{-0.5x}$; $dv = -1$

$f'(x_i) = (4-x)(-0.5\,8^{-0.5x}) - 8^{-0.5x}$

$$\therefore x_{i+1} = \frac{x_i - 8^{-0.5x_i}(4-x_i) - 2}{(4-x_i)(-0.5\,8^{-0.5x_i}) - 8^{-0.5x_i}}$$

at iter = 0 $x = 0.5$

for iter = 1

$x_i = 0.5$

$$x_{i+1} = \frac{0.5 - 8^{-0.5(0.5)}(4-0.5) - 2}{(4-0.5)\times(-0.5\,8^{-0.5\times0.5}) - 8^{-0.5\times0.5}}$$

$x_{i+1} = 0.838890606$ error $= 0.039473322\%$

for iter = 2

$x = 0.838890606$

$$x_{i+1} = 0.838890606 - \frac{8^{-0.5(0.838890606)}(4-0.838890606) - 2}{(4-0.838890606)\times(-0.5\,8^{-0.5\times0.838890606}) - 8^{-0.5(0.838890606)}}$$

$x_{i+1} = 0.884956000$

$$\text{error} = \left|\frac{0.884956000 - 0.838890606}{0.884956000}\right| \times 100$$

$= 5.205388064\%$

for iter 3

$x_i = 0.884956000$

$$x_{i+1} = 0.884956000 - \frac{e^{-0.5(0.884956000)}(4 - 0.884956000) - 2}{(4 - 0.884956000) \times (-0.5e^{-0.5 \times 0.884956000}) - e^{-0.5 \times 0.884956000}}$$

$x_{i+1} = 0.885708605$

$$\text{error} = \left| \frac{0.885708605 - 0.884956000}{0.885708605} \right| \times 100$$

$$= 0.084971964\%$$

for iter 4

$x_i = 0.885708605$

$$x_{i+1} = 0.885708605 - \frac{e^{-0.5(0.885708605)}(4 - 0.885708605) - 2}{(4 - 0.885708605) \times (-0.5e^{-0.5 \times 0.885708605}) - e^{-0.5 \times 0.885708605}}$$

$x_{i+1} = 0.885708802$

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

$$= 0.000000222\%$$

$$= 2.224207319 \times 10^{-7}\%$$

for iter 5

$x_i = 0.885708802$

$$x_{i+1} = 0.885708802 - \frac{e^{-0.5(0.885708802)}(4 - 0.885708802) - 2}{(4 - 0.885708802) \times (-0.5e^{-0.5 \times 0.885708802}) - e^{-0.5 \times 0.885708802}}$$

$x_{i+1} = 0.885708802$

$$\text{error} = \left| \frac{0.885708802 - 0.885708802}{0.885708802} \right| \times 100$$

$= 0$

Iter	x	error (%)
0	0.5	
1	0.838890606	0.039447322
2	0.884956000	5.205388064
3	0.885708605	0.084971964
4	0.885708802	$2.224207319 \times 10^{-7}$
5	0.885708802	0

The root of the equation is 0.885708802

2) $m = 3.5kg$, $g = 9.8ms^{-2}$

$f_0 = mg$

$= 3.5 \times 9.8$

$= 34.3$

Recall $f_0 = \frac{0.3V^2}{500 + (\ln V)^3} - 0.02V$

Substitute the value of f_0

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

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

$$f'(V_i) = \frac{d}{dV}\left[\frac{0.3V_i^2}{500 + (\ln(V_i))^3}\right] - 0.02$$

$$\frac{d}{dV}\left[\frac{0.3V_i^2}{500 + (\ln(V_i))^3}\right] \Rightarrow$$

$a = 0.3V_i^2$ $\quad b = 500 + (\ln(V_i))^3$

$\frac{da}{dV} = 0.6V_i^2$ $\quad \frac{db}{dV} = 3(\ln(V_i))^2\left(\frac{1}{V}\right)$

$$\Rightarrow \frac{b\,da/dV - a\,db/dV}{b^2}$$

$$= \frac{\left[500 + (\ln(V_i))^3 (0.6V_i^2)\right] - \left[0.3V_i^2 (3\ln(V_i))^2 (1/V)\right]}{\left[500 + (\ln(V_i))^3\right]^2} - 0.02$$

$$\therefore V_{i+1} = V_i - \left[\frac{0.3V_i^2}{500 + (\ln V_i)^3} - 0.02V_i - 34.3\right] \Bigg/ \left(\frac{\left[500 + (\ln V_i)^3 (0.6V_i^2)\right] - \left[0.3V_i^2 (3\ln(V_i))^2 (1/V)\right]}{\left[500 + (\ln(V_i))^3\right]^2} - 0.02\right)$$

Matlab code

Command window

```
clear
clc
iter = 0;
v = 18;
for i = 1 : inf
  iter(i+1) = i;
v(i+1) = v(i) - (((0.3* v(i))^2)/(500 + (log (v(i))^3)) - 0.02*(v(i)
      - 34.3)/(((500 + (log (v(i)))^3) * 0.6 * (v(i))) - (0.3* (v(i)
      * (3/v(i) * log (v(i)))^2))/(500 + (log (v(i)))^3) - 0.02));
err(i+1) = abs ((v(i+1) - v(i))/v(i+1) *100;
  if  err(i+1) <= 0.3;
  break
  end
  end
b = [iter'  v'  err']
```

The value of v is 304.067532285 08