

Engineering Math Assignment I

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16/ENG02/033

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8th/03/19

A flat plate of mass, m falling freely in air with velocity, V is subjected to downward gravitational force and an upward frictional drag force due to air. If the drag force, F_d is given by equ (i)

$$F_d = \frac{0.3V^2}{500 + (\ln V)^3} - 0.02V \quad \dots (i)$$

and the terminal velocity is reached when the drag force equals the gravitational force, that is

$$F_d = mg \quad \dots (ii)$$

taking the values of m and g to 3.5 kg and 9.8 m/s² respectively, using a given value of $V = 0.5$ m/s and employing fixed-point iteration method develop a MATLAB program to estimate the

Solution

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

$$F_d = mg$$

Terminal velocity is reached when the drag force = gravitational force

$$m = 3.5, \quad g = 9.8 \text{ m/s}^2$$

$$F_d = mg = 3.5 \times 9.8 = 34.3$$

Putting F_d in equation (i)

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

~~$F_d =$~~

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

$$= 0.3V^2 = (34.3 + 0.02V)(500 + (\ln V)^3)$$

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

$$V_{i+1} = \sqrt{\frac{(34.3 + 0.02V)(500 + (\ln V)^3)}{0.3}}$$

$$\text{at } V = 0.5$$

$$V_{i+1} = \sqrt{\frac{(34.3 + (0.02 \times 0.5))(500 + (\ln 0.5)^3)}{0.3}}$$

$$= \sqrt{\frac{17143.6777}{0.3}}$$

$$= 239.05$$

MathLab Code

```
commandwindow
clear
clc
format short g
close all
v=0.5
for i=1:10;
iter(i+1)=i
v(i+1)=sqrt((34.4+0.02*v(i))*(500+(log(v(i))^3))/0.3);
Ea(i+1)=abs((v(i+1)-v(i))/v(i+1))*100;
if Ea(i+1)<=1E-11
    break
end
end
F=[iter' v' Ea']
A=[iter; v; Ea]
```

Output

v =

0.5

iter =

0 1

iter =

0 1 2

iter =

0 1 2 3

iter =

0 1 2 3 4

iter =

```

      0      1      2      3      4      5

iter =

      0      1      2      3      4      5      6

iter =

      0      1      2      3      4      5      6      7

iter =

      0      1      2      3      4      5      6      7      8

iter =

      0      1      2      3      4      5      6      7      8      9

iter =

      0      1      2      3      4      5      6      7      8      9
10

```

```

F =

      0      0.5      0
      1      239.4      99.791
      2      294.6      18.737
      3      303.05      2.7883
      4      304.29      0.40956
      5      304.48      0.060061
      6      304.5      0.0088058
      7      304.51      0.001291
      8      304.51      0.00018927
      9      304.51      2.7749e-05
     10      304.51      4.0682e-06

```

```

A =

Columns 1 through 10

```

	0	1	2	3
4	5	6	7	8
9	0.5	239.4	294.6	303.05
304.29	304.48	304.5	304.51	304.51
304.51				
	0	99.791	18.737	2.7883
0.40956	0.060061	0.0088058	0.001291	0.00018927
2.7749e-05				

Column 11

10
304.51
4.0682e-06

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