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ENG 382 Assignment I
ENGINEERING MATHEMATICS IV

A flat plate of mass m falling freely in air with velocity V is subject to a downward gravitational force and an upward frictional drag force due to air. If the drag force F_D is given by equation (1).

$$F_D = \frac{0.5V^2}{500 + (\ln V)^3} - 0.02V \quad \text{——(1)}$$

and the terminal velocity is reached when the drag force equals the gravitational force that is $F_D = mg$
Taking the values of m to be 3.5kg and g to be 9.8m/s² using a guess value of $V_0 = 0.5$m/s and employing fixed point iteration method, develop a MATLAB program without using "function" command, to estimate the terminal velocity. Take the absolute percentage relative error tolerance to be less than or equal to 1E-11

SOLUTION

```
Commandwindow
clear
clc
format short
v= 0.5
m= 3.5
g = 9.8
F = m*g
v = sqrt((((F + (0.02*v))*(log(v)^3)) + (10*v) + 1750)/0.3);
for i = 1:inf
    iter(i+1)=i
v(i+1)= sqrt((((F+(0.02*v(i)))*(log(v(i))^3)+(10*v(i))+1750/0.3);
Ea(i+1) = abs(((v(i+1) - v(i)) /(v(i+1))* 100),
if Ea(i+1) <= 1E-11
    break
end
end
table = table(iter', v', Ea')
```

OUTPUT

Iter	V	Ea
0	0 5	
1	239.05	99 79
2	894.17	18.756
3	302 61	2.7894
4	803.85	0 40992
5	304.04	0.060144
6	304.06	0.0088222
7	304.07	0.0012941
8	304.07	0.00018981
9	304.07	2.7842 e-05
10	304 07	4 0838e-06
11	304 07	8 7865e-08
12	304 07	1.2888 e-08
13	304 07	1.8904e-09
14	304.07	2.7727e-10
15	304.07	4.0679 e-11

Converging at iter = 7 , V = 304.07

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

$F_D = 9.8 \times 3.5 = 34.30$ (just for reference)

Substituting V in F_D

$$F_D = \frac{0.3 \times (304.07)^2}{500 + (\ln 304.07)^3} - 0.02(304.07)$$

$F_D = 40.38195731 - 6.0814$

$F_D = 34.3$

Proven correct.