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),

$$F_D = \frac{0.3V^2}{500+(\ln V)^3} - 0.02V \qquad (1)$$

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) + 17150)/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))+17150 /0.3);
    Ea (i+1) = abs (((V(i+1) - V(i)) /V(i+1))* 100);
  if Ea(i+1) <= 1E-11
    break
  end
end
tablo = table (iter', V', Ea')
```

OUTPUT

iter	V	Ea
	0.5	[illegible]
0		99.791
	239.05	
1	294.17	18.736
2		
3	302.61	2.7894
4	303.85	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	4.0838 e-06
11	304.07	8.7865 e-08
12	304.07	1.2888 e-08
13	304.07	1.8904 e-09
14	304.07	2.7727 e-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

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

$F_D = 40.38195731 - 6.0814$

$F_D = 34.3$

$\approx$ Proven correct.