

ABERFORD ALPHA

16/ENG006/002

MECHANICAL ENGINEERING
ENG 302 ASSIGNMENT I

A plate (flat) of mass m , falling freely in air with velocity v is subjected to a downward gravitational force, F_D is given by eqn (1)

$$F_D = \frac{0.3v^2}{500 + (lv)^3} - 0.02v \quad (1)$$

and the terminal velocity is reached when the drag force equals the gravitational force, that is, $F_D = Mg$ --- (2) taking the values of m and g to be 3.5 kg and 9.8 m/s^2 respectively, using a guess value of $v_0 = 0.5 \text{ m/s}$ & employing, fixed-point iteration method, develop a MATLAB Program to estimate the terminal velocity. Take the absolute percentage relative error tolerance to be less than or equal to 1%

Soln

$$F_D = \frac{0.3v^2}{500 + (lv)^3} - 0.02v \quad (1)$$

$$F_D = Mg = 3.5 \times 9.8 = 34.3 \quad (2)$$

equating eqn 1 & 2

$$mg = 34.3 = \frac{0.3v^2}{500 + (lv)^3} - 0.02v$$

Make v^2 subject of formula

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

$$0.3v^2 = (34.3 + 0.02v) \cdot (500 + (lv)^3)$$

$$v^2 = \frac{(34.3 + 0.02v) \cdot (500 + (lv)^3)}{0.3}$$

$$v = \sqrt{\quad}$$

$$v = \sqrt{\frac{(34.3 + 0.02v) \cdot (500 + (lv)^3)}{0.3}}$$

Initial guess value $\Rightarrow v_0 = 0.5 \text{ m/s}$

Absolute % relative error, $E_a(T+1) \leq 1\%$

MECH 302 ALPHA

6/ENG06/202

MECHANICAL ENGINEERING
ASSIGNMENT I

MATLAB

1 - Command window

2 - Clear

3 - Clc

4 - Close all

5 - Format short g

6 - Syms v

7 - v = 0.5

8 - for i = 1:inf

9 - iter(i+1) = i;

10 - $v(i+1) = [(34.3 + (0.02 * v(i)) * (500 + (\log(v(i)))))]^{1/3} / 0.3 \cdot 0.5$

11 - $Ea(i+1) = \text{abs}(v(i+1) - v(i)) / v(i+1) * 100;$

12 - if $Ea(i+1) <= 1E-11$

13 - break

14 - end

15 - end

table = [iter' v' Ea']

The estimated terminal velocity is 204.07 m/s.

Substituting in eqn (1) $T_D = 34.3$