

Ernest Datonye James Akali

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Mechanical Eng

EN6 282.

Ass 1

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

$$F_D = 0.3 v^2$$

$$500 + [\ln v]^3$$

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, developed matlab program to estimate the terminal velocity. Take the absolute percentage relative error tolerance to be less than or equal to $1\text{E}-11$.

Soln

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

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

$$mg = 34.3 = \frac{0.3 v^2}{500 + [\ln v]^3} = 0.02 v$$

making v^2 subject of formula.

$$34.3 + 0.02 v = \frac{0.3 v^2}{500 + [\ln v]^3}$$

$$0.3 v^2 = \frac{[(34.3 + 0.02 v) * (500 + [\ln v]^3)]}{0.3}$$

$$V = \sqrt{\frac{[(34.3 + 0.02v) \times (800 + [1.4v]^3)] \times 10}{3}}$$