Problem 9.141

A light airplane, with mass $M = 1000$ kg, has a conventional-section (NACA 23015) wing of planform area $A = 10$ m^2. Find the angle of attack of the wing for a cruising speed of $V = 63$ m/s. What is the required power? Find the maximum instantaneous vertical "g force" experienced at cruising speed if the angle of attack is suddenly increased.

Given: Data on a light airplane

Find: Angle of attack of wing; power required; maximum "g" force

Solution

The given data or available data is

$$\rho = 1.23 \frac{kg}{m^3} \qquad M = 1000\ kg \qquad A = 10\ m^2$$

$$V = 63 \frac{m}{s} \qquad C_L = 0.72 \qquad C_D = 0.17$$

The governing equations for steady flight are $W = M g = F_L \qquad T = F_D$

where W is the weight T is the engine thrust

The lift coeffcient is given by $F_L = \frac{1}{2} \rho A V^2 C_d$

Hence the required lift coefficient is $C_L = \frac{M g}{\frac{1}{2} \rho A V^2} \qquad C_L = 0.402$