

F22. A long rectangular wing has span b and chord c , and hence the wing area is $S = bc$.

a) The wing airfoil has certain lift and drag coefficients c_ℓ and c_d which are constant across the span. Determine how these relate to the wing's overall C_L and C_D .

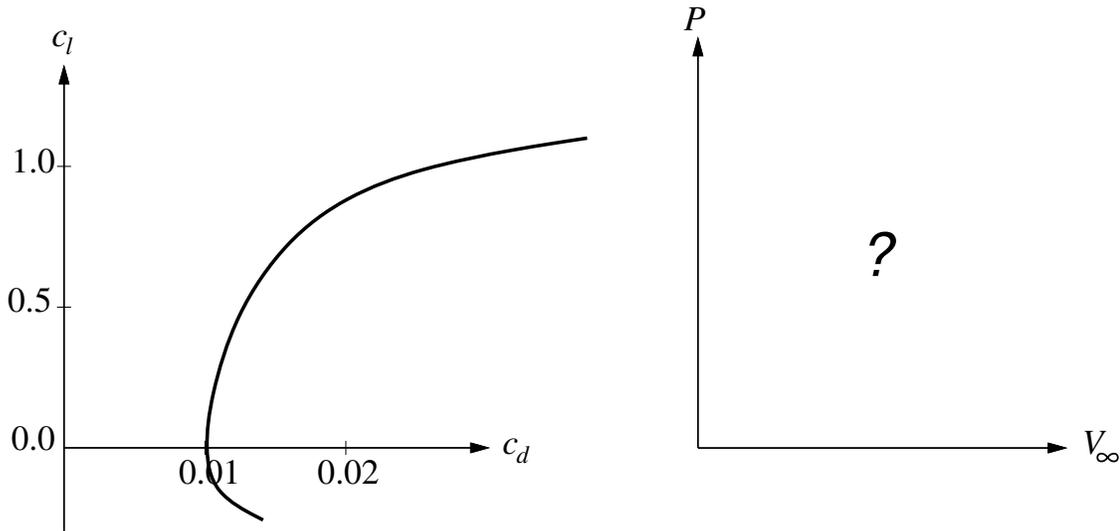
(Hint: Determine L' and D' , then get L and D , then from these determine C_L and C_D).

The wing airfoil has a drag polar which can be approximated by

$$c_d \simeq 0.01 + 0.015 c_\ell^3$$

in the range $c_\ell = 0.1 \dots 1.2$. The propulsive power P needed to overcome drag D at flight speed V_∞ is given by

$$P = D V_\infty$$



b) Determine the form of the $P(V_\infty)$ relation in level flight, and plot it for the range $c_\ell = 0.1 \dots 1.2$. Any constant multiplicative factors on the P and V_∞ axes are not important – only the shape of the curve is of interest. Hint: Simplest approach is to plot $P(c_\ell)$ versus $V(c_\ell)$ with c_ℓ as a dummy parameter.

(Note: Using only the airfoil's c_d ignores other contributions such as induced drag, which become especially significant at low flight speeds!)