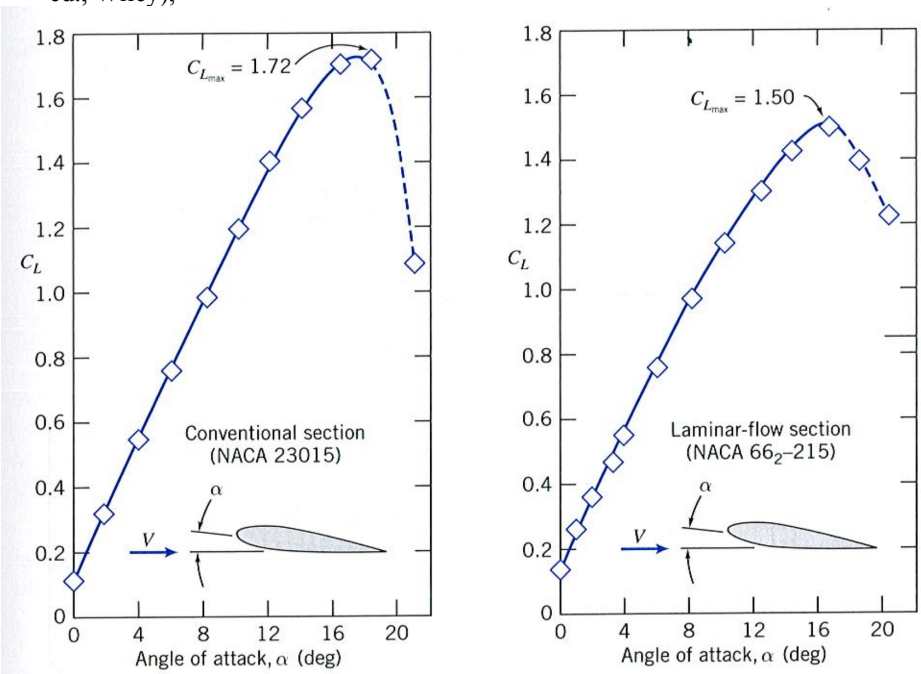
Some cars come with a rear “spoiler” (actually an upside-down airfoil) mounted on the rear of the vehicle that is supposed to increase the down force on the car and improve traction. Calculate a typical down force caused by a rear wing used on a passenger vehicle.

SOLUTION:
The lift force is given by,

$$L = C_L \tfrac{1}{2}\rho V^2 A \,, \qquad (1)$$

where,

A = 2 ft^2 (= 0.186 m^2), assuming a span of 4 ft and a chord length of 0.5 ft (note that this is a planform area),
ρ = 1.23 kg/m^3,
V = 24.6 m/s (= 55 mph),
C_L = 1.4, (a typical value based on Fig. 9.17 from Pritchard et al., *Introduction to Fluid Mechanics*, 8th ed., Wiley),



(*a*) Lift coefficient vs. angle of attack

=> $\boxed{L = 96.9 \text{ N } (= 21.8 \text{ lb}_f)}$

Thus, we see the spoiler produces very little down force on the vehicle.

To produce a down force of 200 lb$_f$ (= 890 N), the car would need to travel at a speed of 70.7 m/s (= 158 mph).

Note that rear spoilers are sometimes used to direct airflow downward to help reduce the size of the trailing wake and thus reduce drag.