

# PS #6

1) Boeing 747-8 climbout @ 150 kts.

1) Determine geometry. + Weight

2) Determine  $C_L$

$$C_L = \frac{L}{\frac{1}{2} \rho V^2 S} = \frac{W}{\frac{1}{2} \rho V^2 S}$$

3) For a swept wing, estimate the Oswald efficiency factor.  $\eta_e$

4) Induced drag

$$C_{D_i} \approx \frac{C_L^2}{\pi A R e}$$

5) Thrust

$$F = C_{D_i} \cdot g \cdot S$$

$$P = F \cdot V = V \cdot g \cdot S \cdot C_{D_i}$$

remember  $550 \frac{\text{ft} \cdot \text{lb}}{\text{s}} = 1 \text{ Hp} = 745 \text{ Watts}$

↑ horsepower

Note: PS is German for "Horse power" but is not quite the same value.

2) Excess Thrust

$$C_D = C_{D_0} + C_{D_i}$$

$$D = \text{Thrust} \Rightarrow \underline{N_0}$$

$$\text{Drag} = C_D \cdot g \cdot S = g \cdot S \cdot (C_{D_0} + C_{D_i})$$

$$\text{Excess thrust} = \text{Thrust} - \text{Drag}$$

$$= 4(66500 \text{ lbf}) - g S (C_{D_0} + C_{D_i})$$

The excess thrust goes into accelerating and climbing (gaining altitude requires power).