ATPL Principles of Flight – Formula Sheet

Airspeed Relationships

$$\text{IAS} \rightarrow \text{CAS} \rightarrow \text{EAS} \rightarrow \text{TAS}$$

$$\text{EAS} = \text{TAS} \times \sqrt{\frac{\rho}{\rho_0}}$$

$$\text{EAS}^2 \propto \text{Lift, Drag}$$

$$\text{At 40,000 ft: } \rho \approx \frac{1}{4} \Rightarrow \text{EAS} \approx \frac{1}{2} \times \text{TAS}$$

Dynamic Pressure

$$Q = \frac{1}{2}\rho V^2$$

Bernoulli's Principle

$$P + \frac{1}{2}\rho V^2 = \text{constant}$$

Lift and Drag

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

$$D = C_D \cdot \frac{1}{2}\rho V^2 S$$

Power and Work

$$\text{Work} = \text{Force} \times \text{Distance}$$

$$\text{Power} = \text{Force} \times \text{Speed}$$

Climb / Descent Performance

$$\sin(\gamma) = \frac{T - D}{W}$$

$$T = D + W \cdot \sin(\gamma)$$

$$L = W \cdot \cos(\gamma)$$

$$\sin(\gamma) = \frac{D - T}{W}$$

$$T = D - W \cdot \sin(\gamma)$$

$$D_{glide} = W \cdot \sin(\gamma)$$

$$D_{power-on} = T + W \cdot \sin(\gamma)$$

$$G\% = \left(\frac{T}{W} - \frac{D}{L}\right) \times 100$$

$$\text{Climb Angle} = \tan^{-1}\left(\frac{G\%}{100}\right)$$

$$\text{RoC} = G\% \times \text{TAS}$$

Speed Performance

$$V_{S_{\text{new}}} = V_{S_{\text{old}}} \cdot \sqrt{\frac{m_{\text{new}}}{m_{\text{old}}}}$$

$$V_{APP_{\text{new}}} = \sqrt{\frac{m_{\text{new}}}{m_{\text{old}}}} \cdot V_{APP_{\text{old}}}$$

Conversions

$$1 \text{ NM} = 1852 \text{ m}$$

$$1 \text{ NM} = 6080 \text{ ft}$$

$$1 \text{ kt} = 0.5144 \text{ m/s}$$