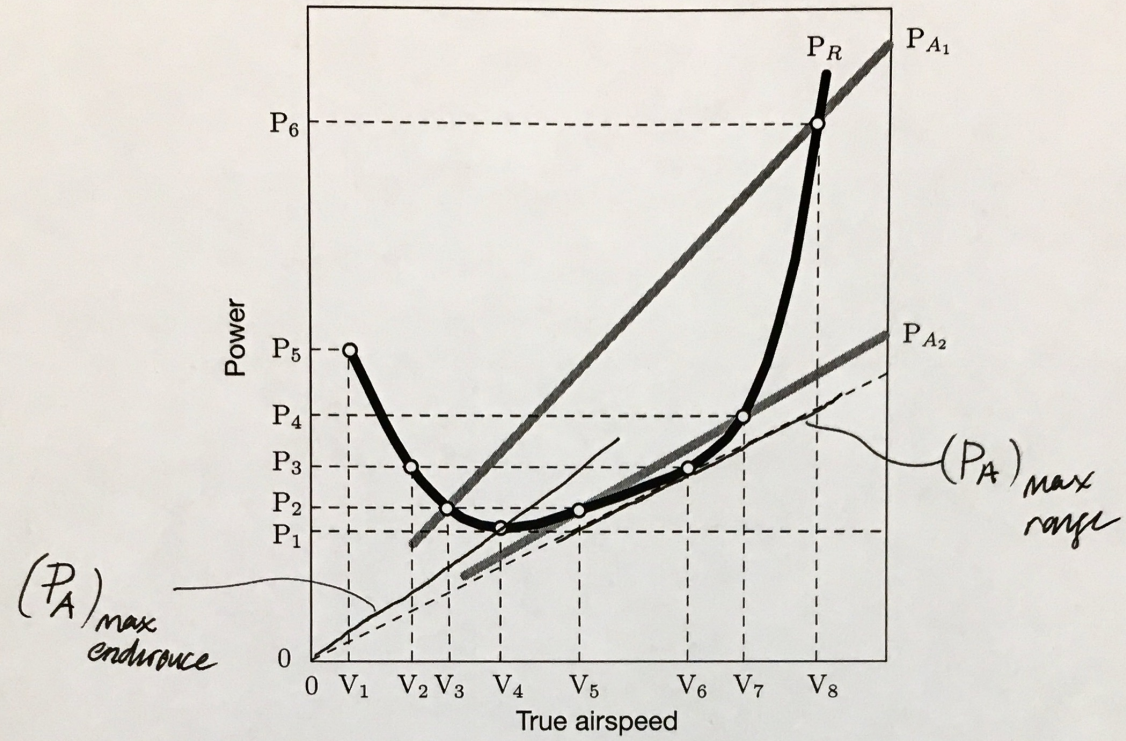
Name: Solution Manual MMAE 410 Pop Quiz 1

1. Consider an aircraft whose thrust is independent of flight speed. Its power required (P_R) and two power available settings (P_{A_1}, P_{A_2}) at a specific flight condition (altitude h, aircraft weight W, angle of attack α, fixed aircraft geometry) are presented in the figure below:



a) The aircraft is initially cruising at the minimum possible speed with P_{A_2} setting. If the pilot adjusts the throttle to P_{A_1} without changing α, will the aircraft accelerate or slow down? Will the aircraft achieve to stabilize its speed? If yes, what will be the ground speed in the existence of a head wind V_w? (35 pt)

$\min(V_5, V_7) = V_5$ at cruise. $T_{A_1} > T_{A_2}$ as slope (P_{A_1}) > slope (P_{A_2}), so A/C will accelerate and stabilize at V_8 (T.A.S). For headwind, $V_G = V_8 - V_W$.

b) The aircraft is initially cruising at maximum endurance. If the pilot adjusts the throttle P_{A_2} without changing α, will the aircraft accelerate or slow down? Will the aircraft achieve to stabilize its speed? If yes, what will be the equilibrium airspeed? (30 pt)

Max. endurance occurs at min (P_R). So, initially cruise at V_4 on $(P_A)_{max\ endurance}$. Slope of P_{A_2} < slope of $(P_A)_{max,endurance}$, i.e. $T_{A_2} < (T_A)_{max,end.}$ So, A/C will slow down to stall speed V_1 (not stabilize itself)

c) The aircraft is initially cruising at maximum range, i.e. $(L/D)_{max}$. If the pilot desire to stabilize aircraft at V_7 without changing α, should he/she increase or decrease the thrust available? How much should he/she change the thrust? (35 pt)

Max range is achieved at (V_6, P_3) on P_R or $(P_A)_{max\ range}$ curves. To stabilize at V_7 $(> V_6)$ increase power to P_{A_2}. Slope of P_{A_2} is greater than that of $(P_A)_{max\ range}$, so thrust should be increased. Initial thrust (T_i) is $\frac{P_3}{V_6}$, final thrust (T_f) should be $\frac{P_4}{V_7}$

$$T_f - T_i = \Delta T = \frac{P_4}{V_7} - \frac{P_3}{V_6} = \text{slope}(P_{A_2}) - \text{slope}(P_{A_{max\ range}})$$