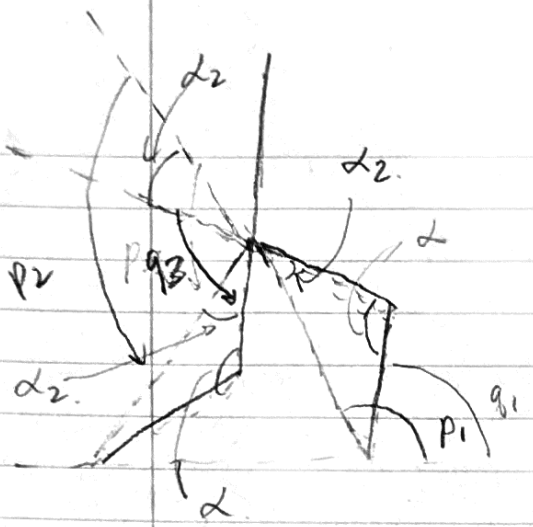


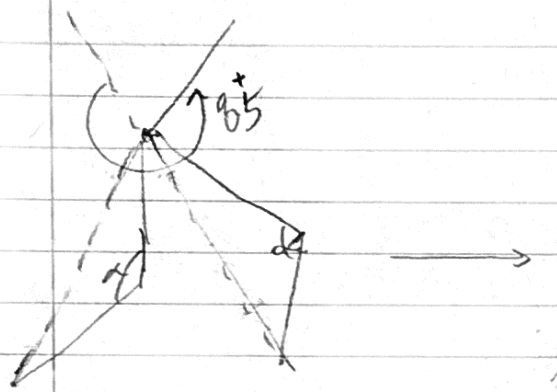
$\begin{bmatrix} p_1 \\ p_2 \end{bmatrix}$ Virtual acrobot

$\begin{bmatrix} q_1 \\ \vdots \\ q_5 \end{bmatrix}$ 5-link robot

$$q_1 = p_1 - \alpha_2 = p_1 - \frac{\pi - \alpha}{2}$$

$$q_3 = p_2 - \beta_1$$

Figure. Deriving From Acrobot.



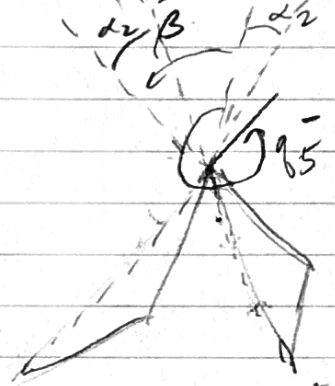


Figure: Obtaining q_5^- from q_5^+

Breakdown of VHCs:

$\phi_2(0) = q_2^+ = q_{2ref}$

$\phi_2(1) = q_2^- = q_{2ref}$

$\phi_4(0) = q_4^+ = q_{4ref}$

$\phi_4(1) = q_4^- = q_{4ref}$

$\phi_4(0.5) = q_{4ref} - \frac{\pi}{4}$

$\phi_5(0) = q_{5ref}$

$\phi_5(1) = q_{5ref} + \beta$

$\phi_5(0.5) = q_{5ref} + \beta/2$

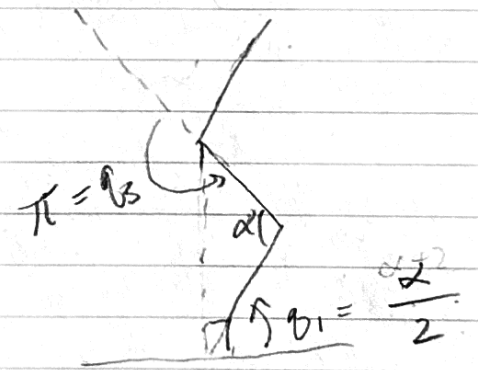


Figure. Obtaining q_1 at $q_3 = a$