Chapter **04** (Bueche & Jerde) ***Static Equilibrium***

P03 $\vec{F}_1$: 240 N, 30° relative to x axis; $\vec{F}_2$: 320 N, 120° relative to x axis; $\vec{F}_3$: F_3, θ_3 relative to $-y$ axis. By $F_1/\sin(120°+\theta_3) = F_2/\sin(150°-\theta_3) = F_3/\sin(90°)$, $4\sin\theta' = 3\sin\theta'$, where $\theta' = \theta + 30°$ or $\theta' = 36.9°$. So $F = 400$ N & $\theta = 6.9°$.

P05 $m_1g = m_2g = 90$ N. $T_1 = T_2 = 90$N. (a) $M = 0$, $T_3 = T_2 + T_1 = 180$ N; (b) $Mg = 25$ N, $T_3 = T_1 + T_2 + Mg = 205$ N .

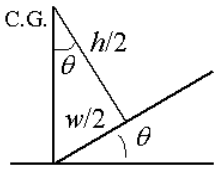
P07 $F_h = 390$ N & $\theta = 70°$. $F\cos\theta = F_h$ & $F\sin\theta = W$ $\Rightarrow$ $W = F_h\tan\theta = 1072$ N .

P08 $F = W\tan\theta$, $W = F/\tan\theta = 240/\tan 30° = 416$ (N) .

P09 & **P10** $F = W\tan\theta$, $\tan\theta = F/W = 310/575$, $\theta = 28.3°$. $T = \sqrt{F^2+W^2}$ $= \sqrt{310^2+575^2}$ $= 653$ (N) .

P19 $W_1 = 600$ N. $T_1 = T_2 = T_4 = W_2$. $T_1 = T_2 = W_1/2 = 300$ N and $T_3 = T_2 + T_4 = 600$ N .

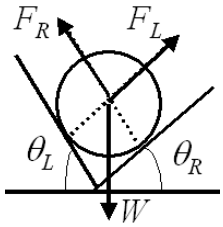
P20 $\Sigma Fy = 3T - mg = 0$ $\Rightarrow$ $T = mg/3 = 540/3 = 180$ (N) .



P41 The critical angle θ_c occurs when the center of gravity is directly above the lower contact. Thus we have $\tan\theta_c = w/h$, where w and h are the width and height, respectively. So, $\theta_c = \tan^{-1}(1/2.5) = 21.8°$.

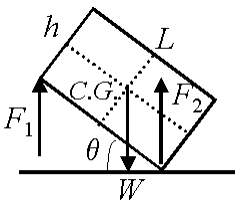
Q. 物體於粗糙斜面上下滑臨界角度$\theta_{c,slip}$為何？

P34 $L = 2$ m, $F_L = 260$ N & $F_R = 200$ N. Taking the center of gravity as the pivot point $F_L\,x = F_R\,(L-x)$, $x = LF_R/(F_L+F_R) = 0.870$ m .



P42 $W = 80$ N, $\theta_L = 60°$ & $\theta_R = 40°$. $F_{net,y} = 0$: $F_L\cos\theta_L + F_R\cos\theta_R = W$ & $F_{net,x} = 0$: $F_L\sin\theta_L = F_R\sin\theta_R$ $\Rightarrow$ $F_L = W\sin\theta_R/\sin(\theta_L+\theta_R) = 52.2$ N & $F_R = W\sin\theta_L/\sin(\theta_L+\theta_R) = 70.4$ N .

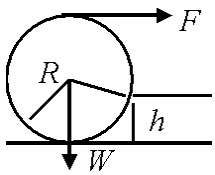
P50 Taking the torques about the center of gravity: $F_1\ell_1 = F_2\ell_2$, where ℓ_1 and ℓ_2 are the lever arms for F_1 and F_2, respectively. Using $h = 0.4L$ & $\theta = 37°$, from the geometry of the figure, $\ell_1 = (L/2)\cos\theta + (h/2)\sin\theta = 0.52L$ & $\ell_2 = L\cos\theta - \ell_1 = 0.28L$. Comparing $\ell_1 > \ell_2$, therefore, $F_2 > F_1$.



P21* $\tau = \ell F = (r\sin\theta)F$ & $\ell = 5.00$ m. $\tau_{90} = \tau_{50} = 0$, $\tau_{60} = [2.50\sin(-90°)](60.0) = -150$ (N·m), $\tau_{80} = (2.50\sin 37°)(80.0) = 120$ (N·m), $\tau_{70} = (5.00\sin 120°)(70.0) = 303$ (N·m).

P48* $R = 52.5$ cm, $h = 18.0$ cm & $W = 1230$ N. Taking the torques about the contact point A, $\tau_{cw} \geq \tau_{ccw} \Rightarrow$

$F_{min}(2R-h) = W\sqrt{R^2-(R-h)^2}$ $\Rightarrow$ $F_{min} = 559$ N .



Q. 有否更省力的方向，將圓盤推上平台？