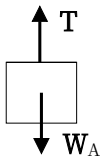
<8.1~8.2절>

8.1　W_A = 25 N,　θ = 30°,　μ_s = 0.35,　μ_k = 0.25



block A,　$\uparrow \Sigma F_y = 0$;

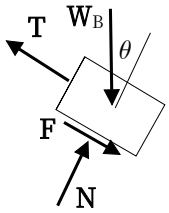
$T - W_A = 0 \quad \Rightarrow \quad T = W_A = 25$ N

block B,　최소 W_B 또는 최대 W_B ⇒ 움직이기 직전

$F = \mu_s N$

$\nearrow \Sigma F_n = 0$;　$N - W_B \cos\theta = 0$

$\Rightarrow \quad N = W_B \cos\theta, \quad F = \mu_s (W_B \cos\theta)$

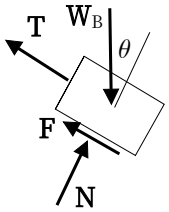


(a) smallest W_B ⇒ 경사면 위로 움직이기 직전

$\nwarrow \Sigma F_t = 0$;　$T - F - W_B \sin\theta = 0$

$\Rightarrow \quad W_A - \mu_s W_B \cos\theta - W_B \sin\theta = 0$

$$\Rightarrow \quad W_B = \frac{W_A}{\sin\theta + \mu_s \cos\theta} = \frac{25\text{ N}}{\sin 30^\circ + (0.35)\cos 30^\circ} = 31.1\text{ N}$$



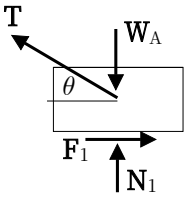
(b) largest W_B ⇒ 경사면 아래로 움직이기 직전

$\nwarrow \Sigma F_t = 0$;　$T + F - W_B \sin\theta = 0$

$\Rightarrow \quad W_A + \mu_s W_B \cos\theta - W_B \sin\theta = 0$

$$\Rightarrow \quad W_B = \frac{W_A}{\sin\theta - \mu_s \cos\theta} = \frac{25\text{ N}}{\sin 30^\circ - (0.35)\cos 30^\circ} = 127.0\text{ N}$$

8.13　W_A = 16 N,　W_B = 24 N,　μ_s = 0.20,　P = 10 N



블럭 A에서,　$F_1 = \mu_s N_1$　(∵ motion is impending)

$\uparrow \Sigma F_y = 0$;　$N_1 - W_A + T \sin\theta = 0$

$\Rightarrow \quad N_1 = W_A - T \sin\theta$

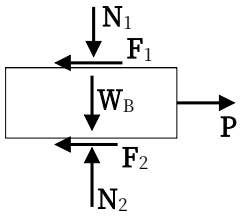
$\rightarrow \Sigma F_x = 0$;　$F_1 - T \cos\theta = 0$

$\Rightarrow \quad \mu_s (W_A - T \sin\theta) - T \cos\theta = 0$

$$\Rightarrow \quad T = \frac{\mu_s W_A}{\cos\theta + \mu_s \sin\theta}$$

$$\Rightarrow \quad N_1 = W_A - \frac{\mu_s W_A}{\cos\theta + \mu_s \sin\theta}\sin\theta = \frac{W_A \cos\theta}{\cos\theta + \mu_s \sin\theta}$$

$$\Rightarrow \quad F_1 = \frac{\mu_s W_A \cos\theta}{\cos\theta + \mu_s \sin\theta}$$



블록 B에서,　$F_2 = \mu_s N_2$　(∵ motion is impending)

$\uparrow \Sigma F_y = 0$;　$N_2 - N_1 - W_B = 0$

$$\Rightarrow \quad N_2 = N_1 + W_B = \frac{W_A \cos\theta}{\cos\theta + \mu_s \sin\theta} + W_B$$

$$\rightarrow \Sigma F_x = 0 \; ; \quad -F_1 - F_2 + P = 0$$

$$\Rightarrow \quad -\frac{\mu_s W_A \cos\theta}{\cos\theta + \mu_s \sin\theta} - \mu_s \left(\frac{W_A \cos\theta}{\cos\theta + \mu_s \sin\theta} + W_B \right) + P = 0$$

$$\Rightarrow \quad -2 \mu_s W_A \cos\theta + (-\mu_s W_B + P)(\cos\theta + \mu_s \sin\theta) = 0$$

$$\Rightarrow \quad (-\mu_s W_B + P) \mu_s \sin\theta = (2 \mu_s W_A + \mu_s W_B - P) \cos\theta$$

$$\Rightarrow \quad \tan\theta = \frac{2 \mu_s W_A + \mu_s W_B - P}{(-\mu_s W_B + P)\mu_s} = \frac{2(0.20)(16\text{ N}) + (0.20)(24\text{ N}) - (10\text{ N})}{[-(0.20)(24\text{ N}) + (10\text{ N})](0.20)}$$

$$= 1.1538 \qquad \Rightarrow \qquad \theta = \tan^{-1}(1.1538) = 49.1^\circ$$

8.18 $M = 50$ N·m, $\mu_s = 0.40$, $\mu_k = 0.30$

$F = \mu_s N$ ($\because$ smallest force if the drum is not to rotate)

(a) clockwise couple

$\Sigma M_D = 0$;

$$(0.250\text{ m})\, F - M = 0$$

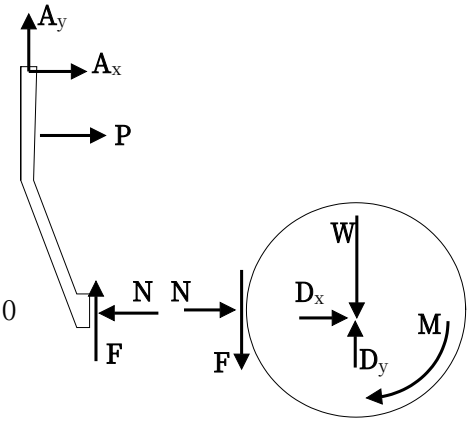
$$\Rightarrow \quad F = \frac{M}{0.25\text{ m}} = \frac{50\text{ N} \cdot \text{m}}{0.25\text{ m}} = 200\text{ N}$$

$\Sigma M_A = 0$;

$$(0.150\text{ m})\, P + (0.150\text{ m})\, F - (0.450\text{ m})\, N = 0$$

$$\Rightarrow \quad P = -F + 3\frac{F}{\mu_s} = \left(-1 + \frac{3}{\mu_s}\right) F$$

$$= \left(-1 + \frac{3}{0.4}\right)(200\text{ N}) = 1300\text{ N}$$



(b) counterclockwise couple

$\Sigma M_D = 0$;

$$-(0.250\text{ m})\, F + M = 0$$

$$\Rightarrow \quad F = \frac{M}{0.25\text{ m}} = \frac{50\text{ N} \cdot \text{m}}{0.25\text{ m}} = 200\text{ N}$$

$\Sigma M_A = 0$;

$$(0.150\text{ m})\, P - (0.150\text{ m})\, F - (0.450\text{ m})\, N = 0$$

$$\Rightarrow \quad P = F + 3\frac{F}{\mu_s} = \left(1 + \frac{3}{\mu_s}\right) F$$

$$= \left(1 + \frac{3}{0.4}\right)(200\text{ N}) = 1700\text{ N}$$