ENGINEERING MECHANICS - STATICS

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FRICTION- Numerical

Session- 5

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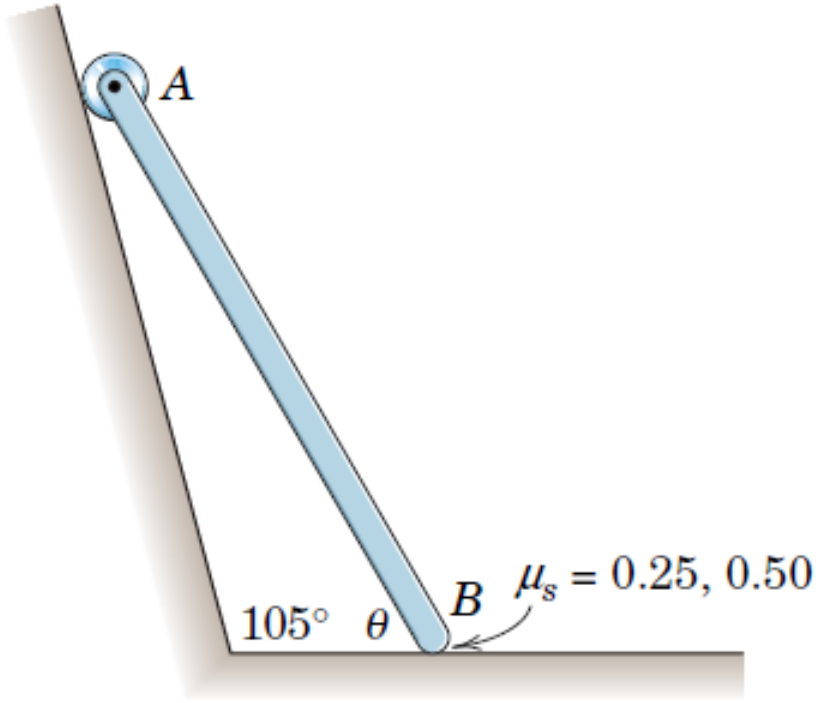
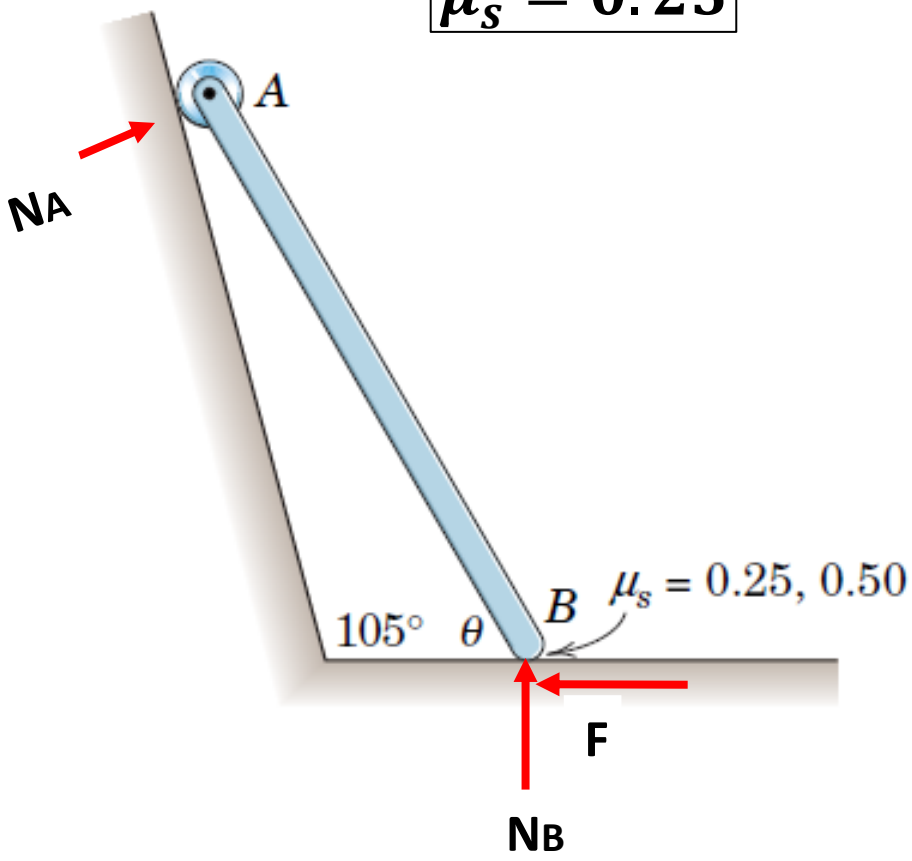
Friction- Numerical

- **Problem 6/18:** The uniform slender bar has an ideal roller at its upper end A. Determine the minimum value of the angle θ for which equilibrium is possible for $\mu_s = 0.25$ and for $\mu_s = 0.50$.



$\boldsymbol{\mu_s = 0.25}$



Applying the conditions of equilibrium

$$\sum F_x = 0, \quad N_A \, Cos\, 15 \; - 0.25 \, N_B = 0 \Longrightarrow N_A = 0.2588 N_B$$

$$\sum F_y = 0, \quad N_A \, Sin\, 15 \; - mg + N_B = 0$$

$$N_B = \frac{mg}{1.066}$$

$$\sum M_A = 0$$

$$-0.25 \, N_B \, l \, cos\theta + N_B \, l \, cos\theta \; - mg \frac{l cos\theta}{2} = 0$$

simplifying the above equation

$$\tan\theta = 1.868 \Longrightarrow \; \theta = 61.84$$

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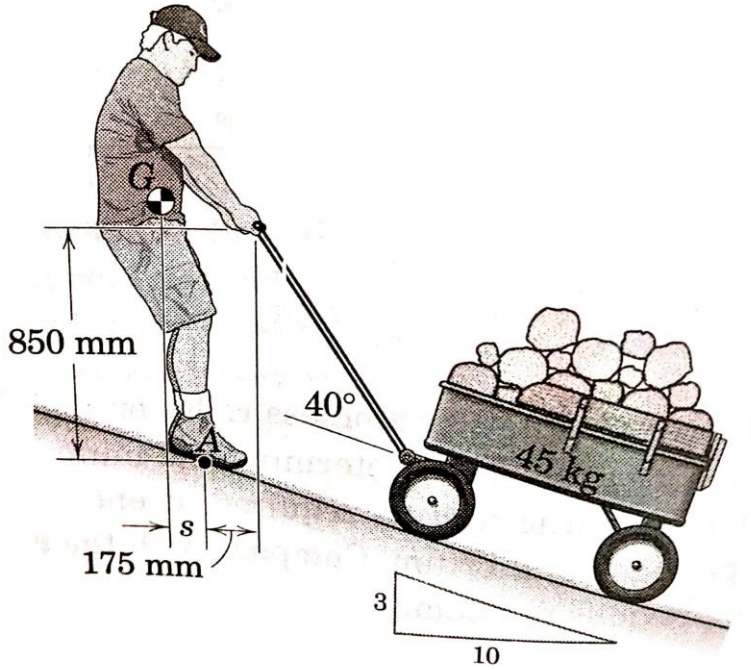
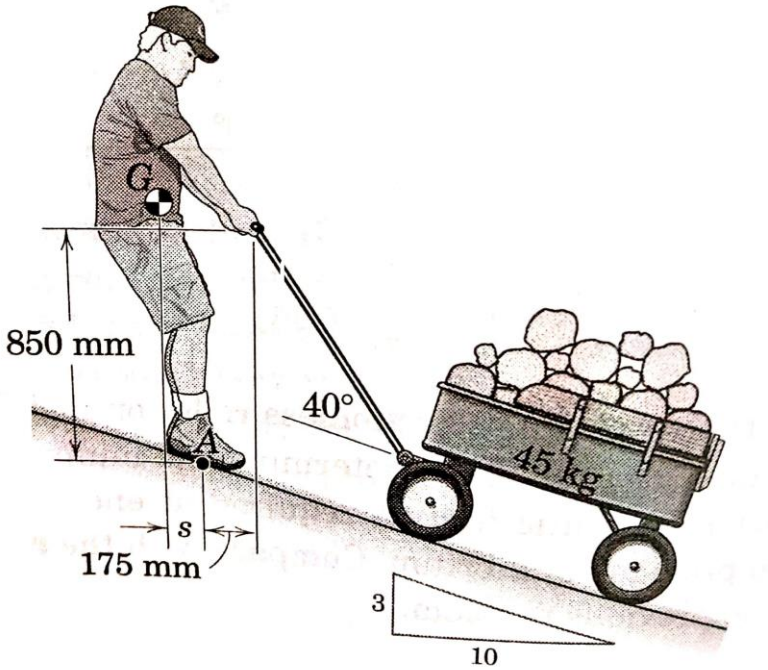
Friction- Numerical

- Problem 6/23: A 82-kg man pulls the 45-kg cart up the incline at steady speed. Determine the minimum coefficient μ_s of static friction for which the man's shoes will not slip. Also determine the distance *s* required for equilibrium of the man's body.



Problem 6/23: Solution



$$\theta = \tan^{-1}\left(\frac{3}{10}\right) = 16.7$$

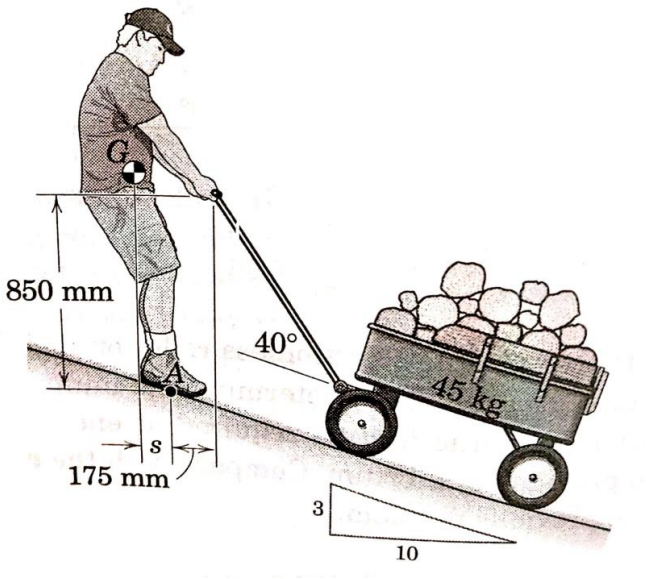
Considering the FBD of Cart & Applying the conditions of equilibrium

$$\sum F_x = 0$$

$$F\cos 40 - (45\ X\ 9.81)\sin\theta = 0$$

$$F = 165.6\ N$$

Friction- Numerical



Considering the FBD of Man & Applying the conditions of equilibrium

$$\sum \boldsymbol{M_A} = \mathbf{0}$$

$$(82\ X\ 9.81)(s)$$
$$-F\cos(40 + \theta)(850) - F\sin(40 + \theta)(175) = 0$$

$$s = 126.2\ mm$$

$$\sum \boldsymbol{F_x} = \mathbf{0}$$

$$F_A - (82\ X\ 9.81)\sin(16.7) - F\cos(40) = 0$$

$$F_A = 358.91\ N$$

$$\sum \boldsymbol{F_y} = \mathbf{0}$$

$$N_A - (82\ X\ 9.81)\cos\theta + F\sin(40) = 0$$

$$N_A = 876.93$$

$$\mu_A = \frac{F_A}{N_A} = 0.409$$

THANK YOU

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