



# ENGINEERING MECHANICS - STATICS

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Department of Civil Engineering

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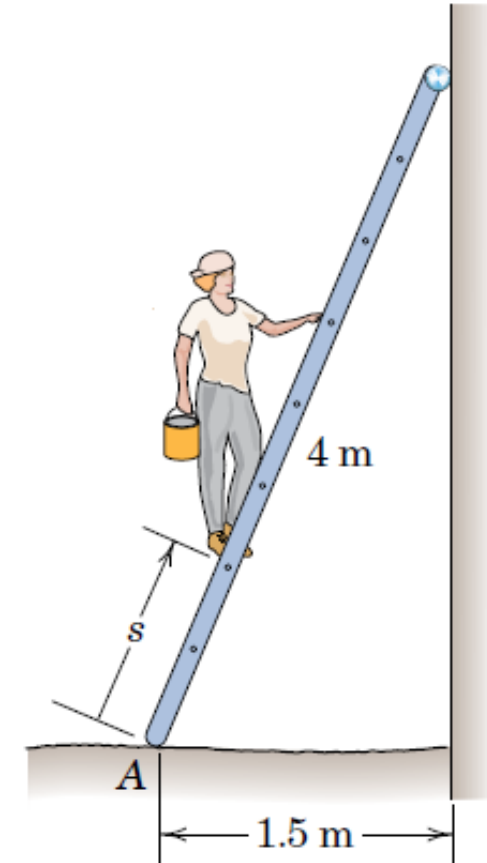
## FRICTION- Numerical

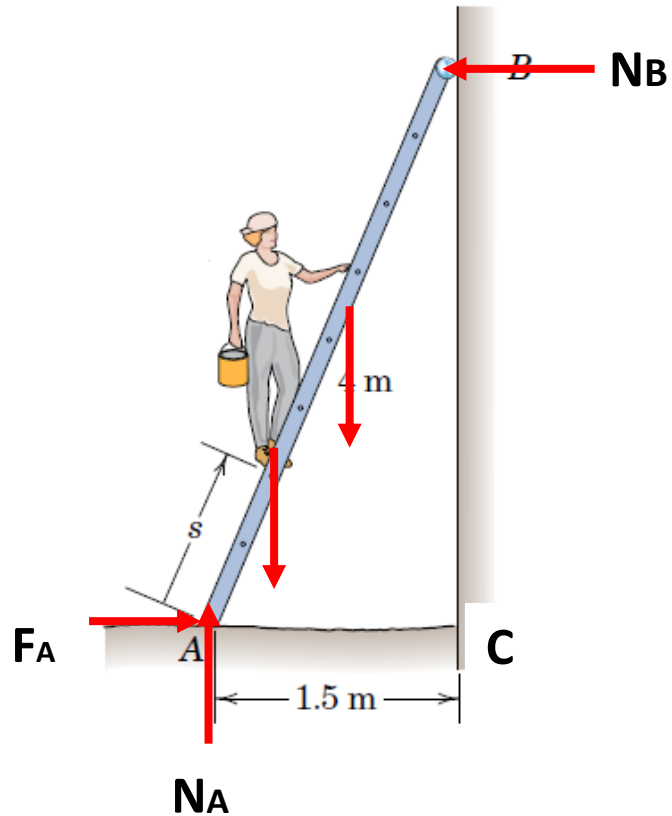
### Session- 6

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- 6/33 Determine the distance  $s$  to which the 90-kg painter can climb without causing the 4-m ladder to slip at its lower end A. The top of the 15-kg ladder has a small roller, and at the ground the coefficient of static friction is 0.25. The mass center of the painter is directly above her feet.





$$\theta = \cos^{-1} \left( \frac{1.5}{4} \right) = 67.97$$

$$\overline{CB} = 3.708 \text{ m}$$

**Considering the FBD of ladder & Applying the conditions of equilibrium**

weight of the ladder  $W_l = 15 \times 9.81 = 147.15 \text{ N}$

$$\sum F_x = 0$$

$$0.25N_A = N_B \text{-----(1)}$$

$$\sum F_y = 0$$

$$N_A = W_l + W_m = 1030.05 \text{ N}$$

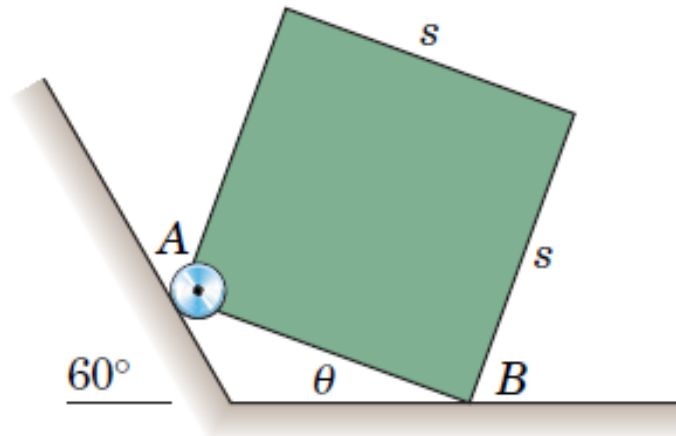
from equation (1)  $N_B = 257.512 \text{ N}$

$$\sum M_A = 0$$

$$-W_m (s \cos \theta) - W_l (2 \cos \theta) + N_B (\overline{BC}) = 0$$

$$s = 2.55 \text{ m}$$

- 6/36. The homogeneous square body is positioned as shown. If the coefficient of static friction at B is 0.40, determine the critical value of the angle  $\theta$  below which slipping will occur. Neglect friction at A.



### Problem 6/36: Solution

$$\sum F_x = 0$$

$$+ N_A \cos(30) - 0.4 N_B = 0$$

$$N_B = 2.165 N_A$$

$$\sum F_y = 0$$

$$N_A \sin 30 + N_B - mg = 0$$

$$N_A = \frac{mg}{2.664}$$

$$\sum M_B = 0$$

$$-mg \sin \theta \left( \frac{s}{2} \right) + mg \cos \theta \left( \frac{s}{2} \right)$$

$$- N_A \cos 30 s \sin \theta - N_A \sin 30 s \cos \theta = 0$$

*Simplifying the above equation*

$$\tan \theta = 0.3785$$

$$\theta = 20.73$$



# THANK YOU

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