ENGINEERING MECHANICS - STATICS

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Department of Civil Engineering

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FRICTION

Session- 2

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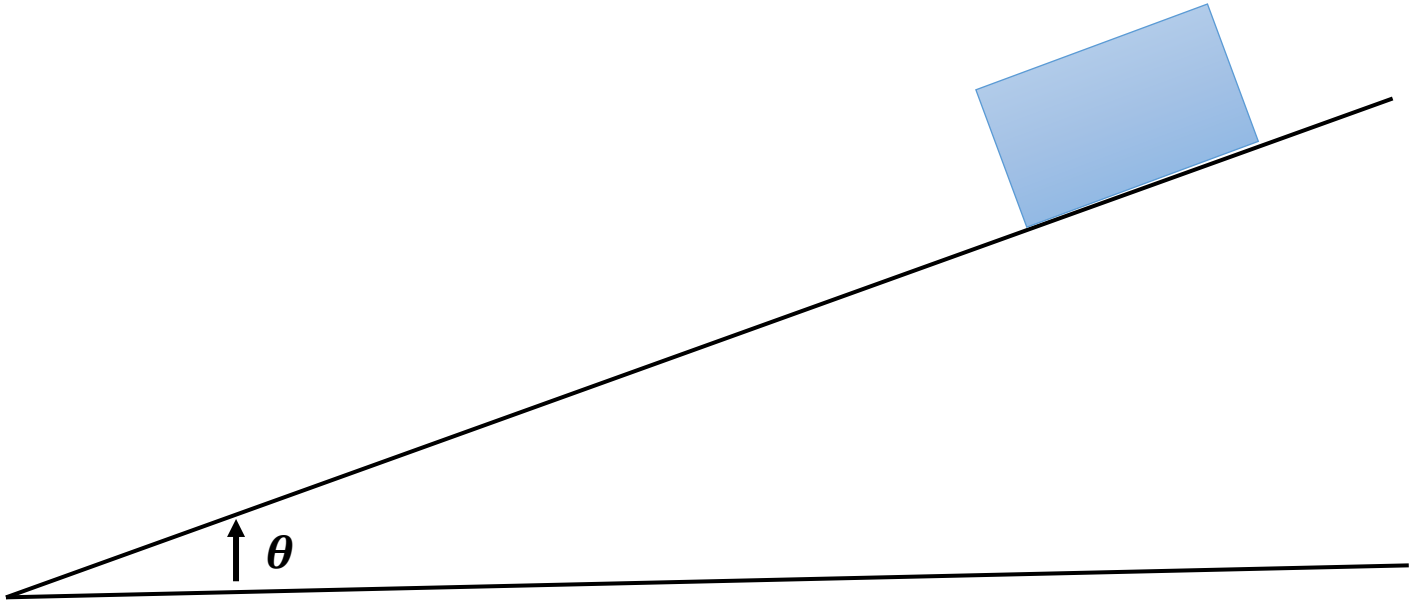
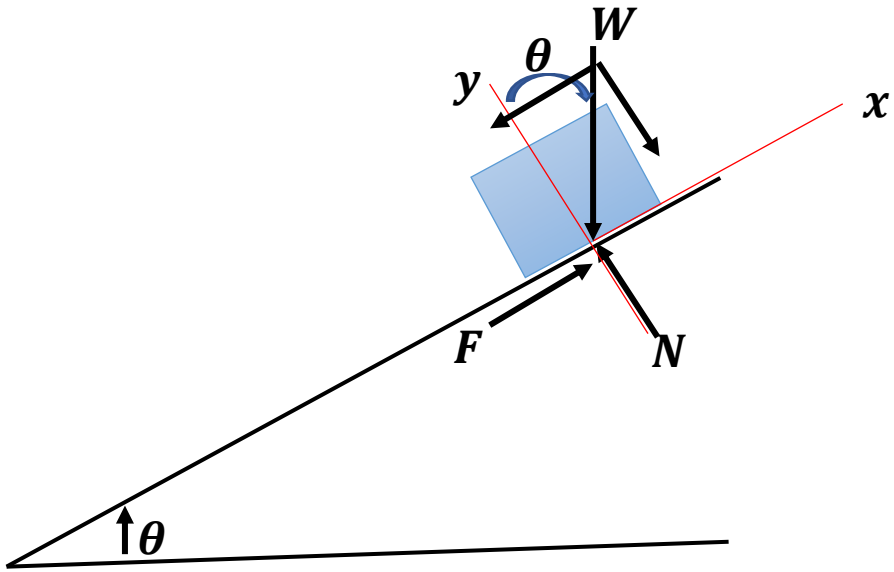
Angle of repose



Angle of repose

Applying the conditions of equilibrium:



$$\sum F_x = 0 \qquad -W\sin(\theta) + F = 0$$

$$F = W\sin(\theta) \text{ ---(1)}$$

$$\sum F_y = 0 \qquad -W\cos(\theta) + N = 0$$

$$N = W\cos(\theta) \text{ ---(2)}$$

when the motion is impending Frictional force will be

$F_{max} = \mu_s N$ (*substituting in* (1)

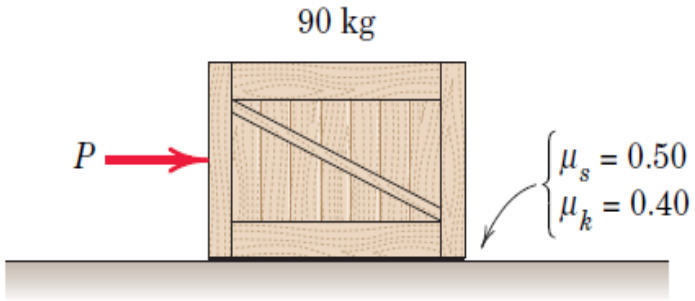
$\mu_s N = W\sin(\theta)$ from (2)

$\mu_s W\cos(\theta) = W\sin(\theta)$ $\quad \boxed{\mu_s = \tan(\theta_{max})}$

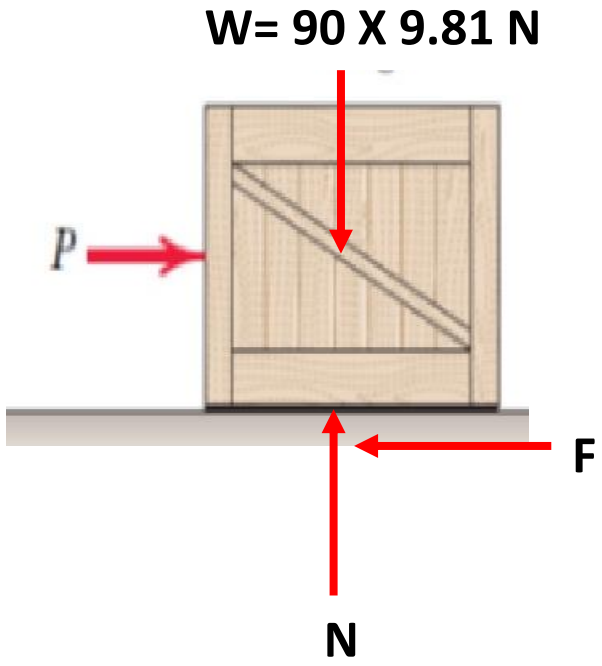
$\boxed{\theta_{max} = \tan^{-1}(\mu_s)}$

Friction

Problem 6/1: The force *P* is applied to the 90-kg crate, which is stationary before the force is applied. Determine the magnitude and direction of the friction force *F* exerted by the horizontal surface on the crate if (*a*) *P* = 300 N, (*b*) *P* = 400 N, and (*c*) *P* = 500 N.



Problem 6/1: Solution



(a) When P = 300 N

$$\sum F_x = 0 \quad (P) - F = 0 \quad F = 300\ N$$

$$\sum F_y = 0 \quad -(90 \times 9.81) + N = 0 \quad N = 882.9\ N$$

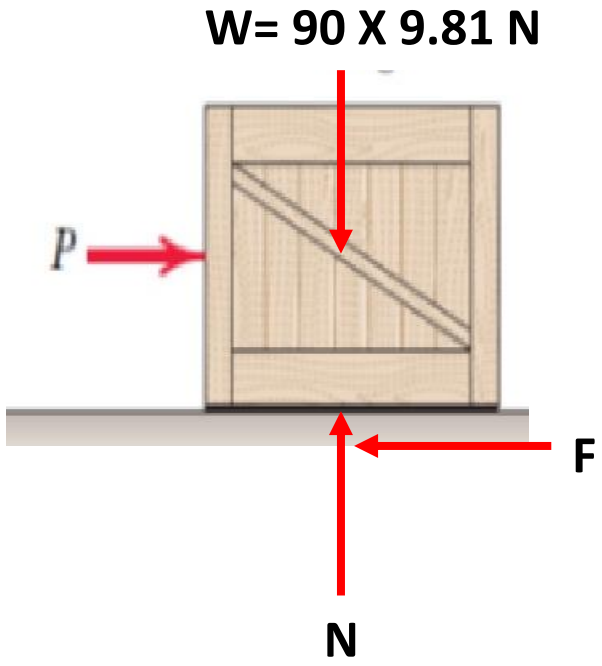
$$F_{max} = \mu_s N = 0.5\ N = 441.45\ N$$

$Since\ F < F_{max},$

$$\boxed{F = 300\ N\ Left}$$

Problem 6/1: Solution

(b) P = 400 N



$$\sum F_x = 0 \qquad (P) - F = 0 \quad F = 400\ N$$

$$\sum F_y = 0 \qquad -(90 \times 9.81) + N = 0 \quad N = 882.9\ N$$

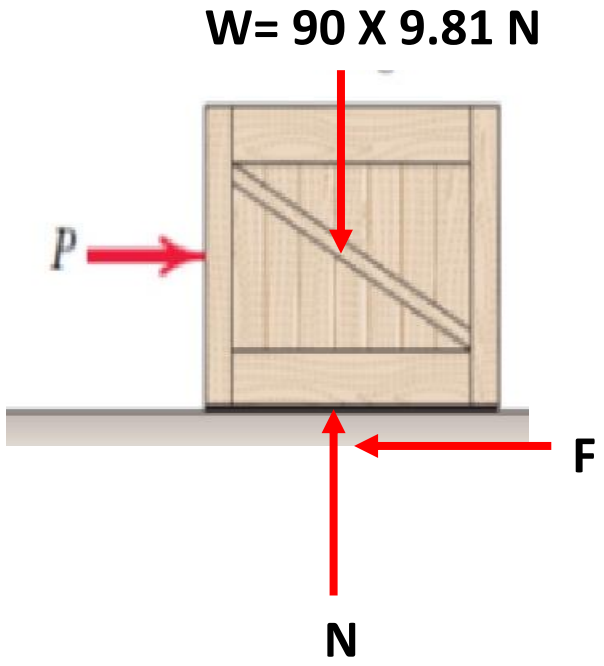
$$F_{max} = \mu_s N = 0.5\ N = 441.45\ N$$

$$Since\ F < F_{max}$$

$$\boxed{F = 400\ N\ Left}$$

Problem 6/1: Solution

(c) P = 500 N



$$\sum F_x = 0 \qquad (P) - F = 0 \quad F = 500\ N$$

$$\sum F_y = 0 \qquad -(90 \times 9.81) + N = 0 \quad N = 882.9\ N$$

$$F_{max} = \mu_s N = 0.5\ N = 441.45\ N$$

Since $F > F_{max}$, *clearly the condition is impossible, the motion occurs*

The frictional force F = $\mu_k N = 0.4(882.9)$

$$\boxed{F = 353.2N\ left}$$

THANK YOU

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