UF | UNIVERSITY of FLORIDA

Pre-Health Post-Baccalaureate Program
PHY2053 Study Guide & Practice Problems

Topics Covered:

Rotational Equilibrium
Hooke's Law
Young's Modulus

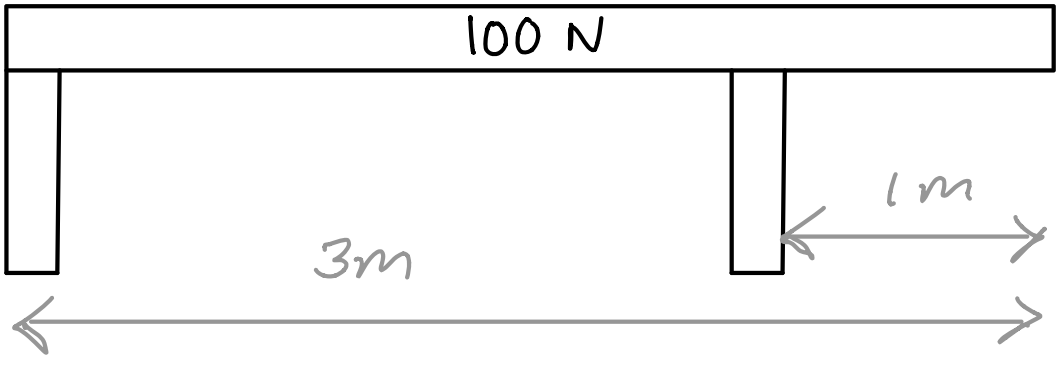
Created by Isaac Loy

Rotational Equilibrium

→ For an object to be in rotational equilibrium, the net torque about any point must be equal to zero.

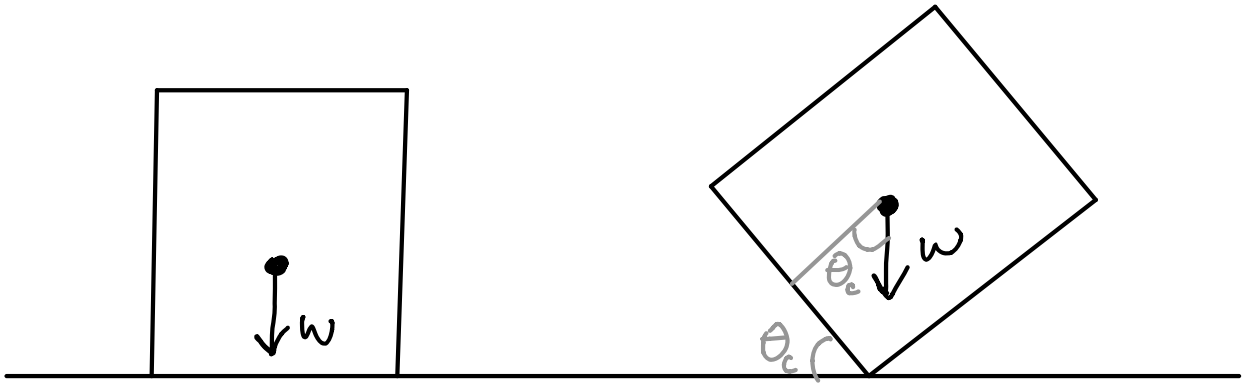
→ Pick a pivot point that simplifies your calculation!

① The board weighs 100 N. What are the magnitudes of the two normal forces (n_1 and n_2) from the supporting planks?



→ To find the critical angle, θ_c (the point at which an object tips), position the object such that its weight is directly above the pivot point.

Ex:

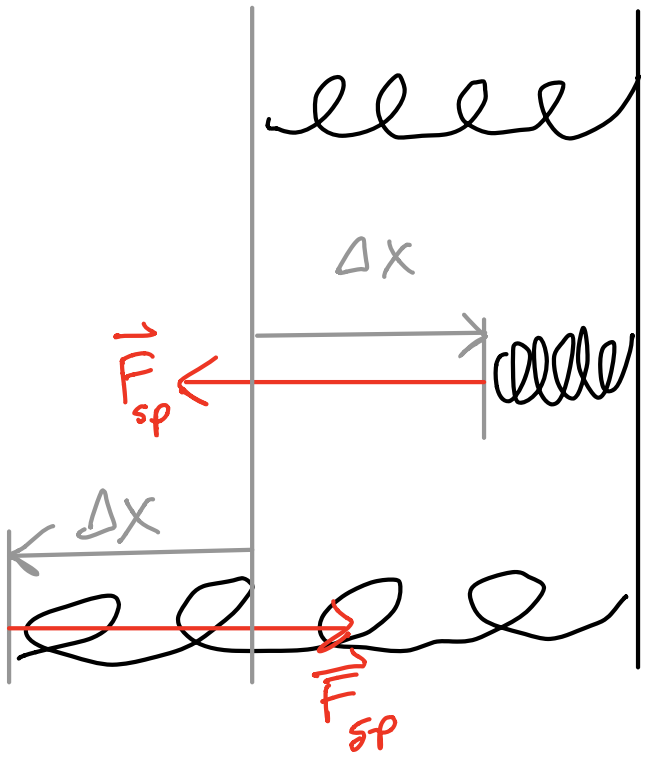


Hooke's Law

→ Hooke's Law states that the restoring force of a spring is directly proportional to the displacement of the spring:

$$F_{sp} = kx$$

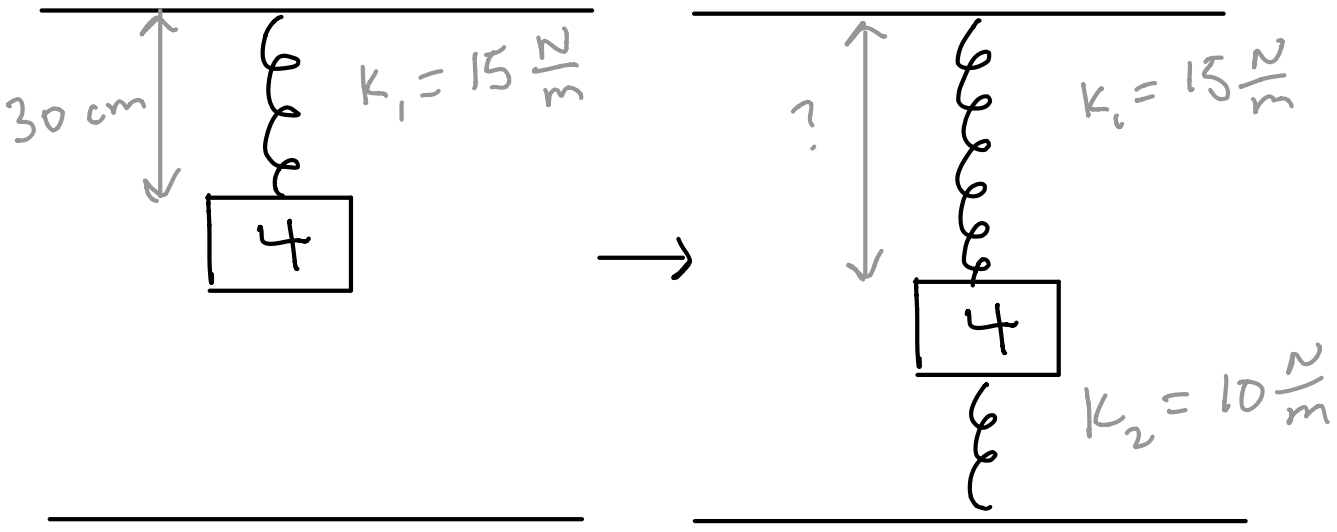
where F (N) is the restoring force, k ($\frac{N}{m}$) is the spring constant, and x (m) is the displacement.



→ k is a property of the spring

→ Include F_{sp} in FBDs!

(2) A 4 kg mass, connected by a spring ($k = 15 \frac{N}{m}$), hangs 30 cm below a ceiling. The mass is then connected to the ground by a second spring, which is stretched 30 cm from its equilibrium position after being connected. After attaching the second spring, how far from the ceiling is the mass?



Young's Modulus

→ Young's Modulus (Y) is a constant and property of a material which allows us to relate the spring constant (k) of a rod with the rod's area (A) and length (L):

$$K = \frac{YA}{L}$$

→ Because Hooke's Law states that $F = K\Delta X$, we can substitute the above k value into that equation:

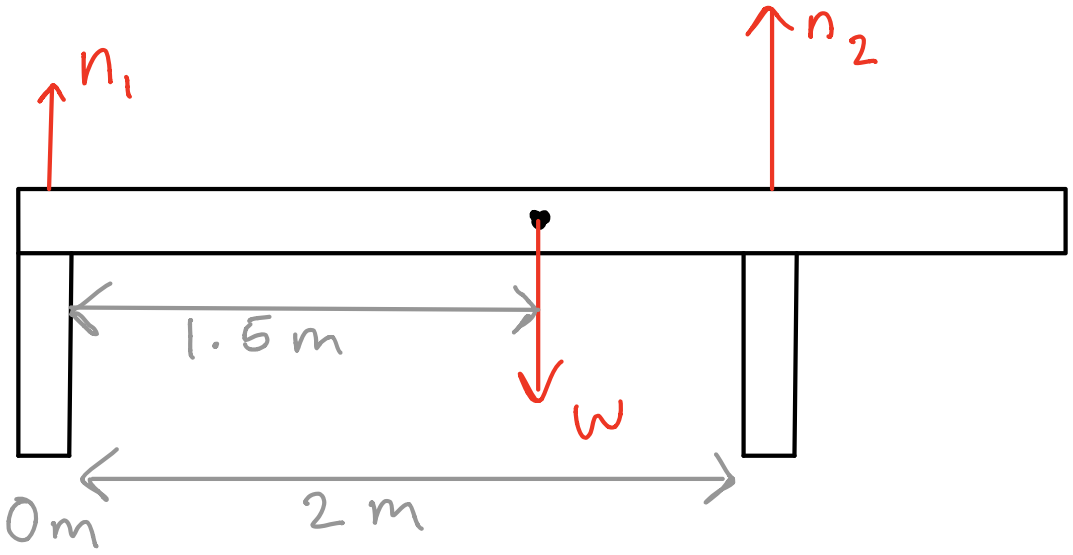
$$F = \frac{YA}{L}\Delta L$$

→ By rearranging, we get:

$$\frac{F}{A} = Y\left(\frac{\Delta L}{L}\right)$$

where $\frac{F}{A}$ is known as "stress", and $Y\left(\frac{\Delta L}{L}\right)$ is known as "strain"

Solutions

① 

$$\sum \tau = 0$$

$$-1.5w + 2n_2 = 0$$

$$2n_2 = 1.5w$$

$$n_2 = \frac{1.5w}{2} = \frac{1.5(100)}{2} = \boxed{75\ N}$$

$$\sum F_y = 0$$

$$n_1 + n_2 - w = 0$$

$$n_1 = w - n_2 = 100N - 75\ N = \boxed{25N}$$

(2) $F_{sp_1} = F_{sp_2}$

$K_1 \Delta x_1 = K_2 \Delta x_2$

$\Delta x_1 = \frac{K_2 \Delta x_2}{K_1} = \frac{10(.3)}{15} = .2m$

$x + \Delta x = .3m + .2m = \boxed{.5m}$