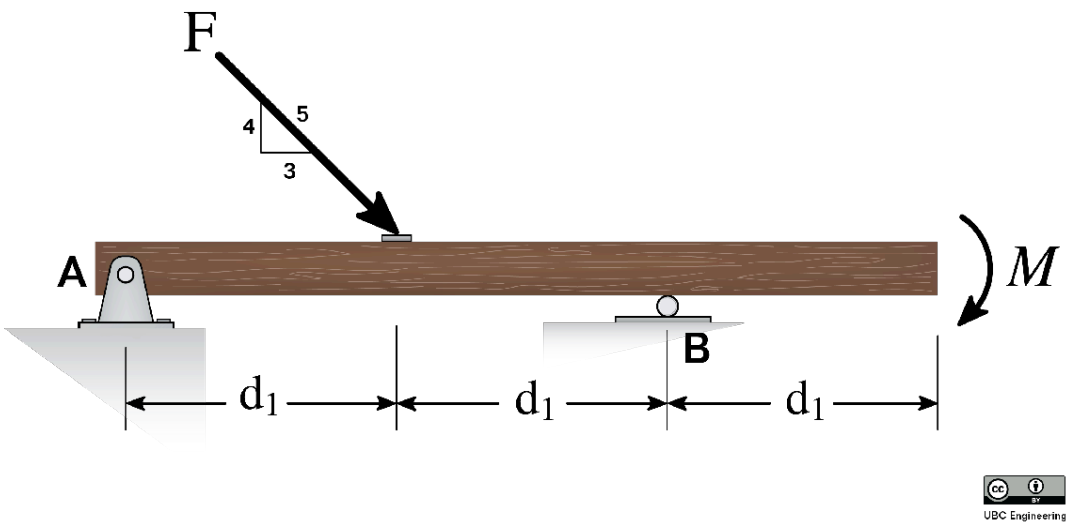
21-S-4.8-RP-03



A wooden plank supports a force F and a moment M as shown above. If the plank can be divided into 3 equal sections of length d_1, simplify the loading into a single force and identify the location on the plank, x, where the equivalent force acts on (distance from A). Find the magnitude of the equivalent force and the smallest positive angle, θ, between the plank and the equivalent force.

$$\overrightarrow{F_E} = \overrightarrow{F}$$

$$\Rightarrow F_E = F$$

$$\theta = \tan^{-1}\left(\frac{4}{3}\right)$$

$$M_A = d_1 \frac{4}{5} F + M = x \cdot \frac{4}{5} F_E$$

$$\rightarrow x = \frac{d_1 \frac{4}{5} F + M}{\frac{4}{5} F_E}$$

$$\Rightarrow x = d_1 + \frac{5M}{4F_E}$$