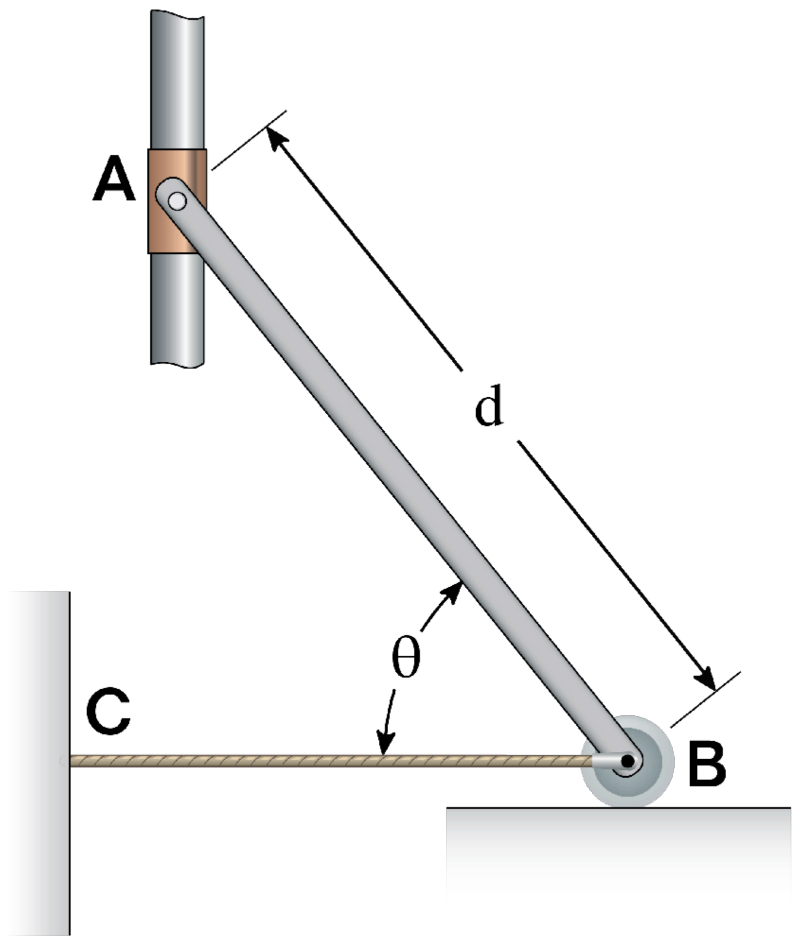
21-S-5.4-RP-06



A bar AB with a total uniform mass of $m\,\mathrm{kg}$ is supported by a smooth collar attached through a pin at point A, a roller at point B, and a cable BC. Find the magnitude of the reaction forces F_A, F_B, and F_{BC}, as well as the counter clockwise angle, θ such that $0^\circ \le \theta < 360^\circ$, between the force vector and the positive x - axis (horizontal line). Assume $g = 9.81\ \mathrm{N/kg}$.

$A_y = B_x = BC_y = 0\,\mathrm{N}$

None of the supports used create moments internally.

All components are assumed to be pointing upwards or to the right

$\Sigma F_x = 0 \rightarrow A_x + BC_x = 0 \rightarrow A_x = -BC_x$

BC_x *is directed to the left since it is a tension force (- value)*

$$\Sigma F_y = 0 \rightarrow B_y - mg = 0 \rightarrow B_y = mg$$

$$\Sigma M_B = 0 \rightarrow \frac{d}{2} \cdot mg\cos(\theta) - d \cdot A_x \sin(\theta) = 0 \rightarrow A_x = \frac{mg}{2\tan(\theta)} = -BC_x$$

$$F_A = \sqrt{{A_x}^2 + {A_y}^2} = A_x$$

$$F_B = \sqrt{{B_x}^2 + {B_y}^2} = B_y$$

$$F_{BC} = \sqrt{{BC_x}^2 + {BC_y}^2} = |BC_x|$$

$$\theta_A = \tan^{-1}\left(\frac{A_y}{A_x}\right) = \tan^{-1}\left(\frac{0}{A_x}\right)$$

Since A_x is positive, $\theta_A = 0°$

$$\theta_B = \tan^{-1}\left(\frac{B_y}{B_x}\right) = \tan^{-1}\left(\frac{B_y}{0}\right)$$

Since B_y is positive, $\theta_B = 90°$

$$\theta_{BC} = \tan^{-1}\left(\frac{BC_y}{BC_x}\right) = \tan^{-1}\left(\frac{0}{BC_x}\right)$$

Since BC_x is negative, $\theta_{BC} = 180°$