Answer on Question #74183, Physics / Mechanics — Relativity

Question A ladder 2.5m long weighing hundred kg rest with one end on a smooth vertical wall and with the other end on the floor. The lowest end of the ladder is hinged to a point distant 0.7m from the wall. Find the reactions of the wall and the hinge.

Solution We will use notation of force, which is shown on the graph below. We need to find forces F_w and F_{ff}. We use balance condition in x direction for forces that act on ladder to find that:

$$F_{ff} = F_w$$

For y direction we obtain:

$$F_g = mg = F_f + F_{fw}$$

The resultant moment of the forces about the random point equals zero:

$$M_f - M_w - M_{ff} - M_{fw} = 0$$

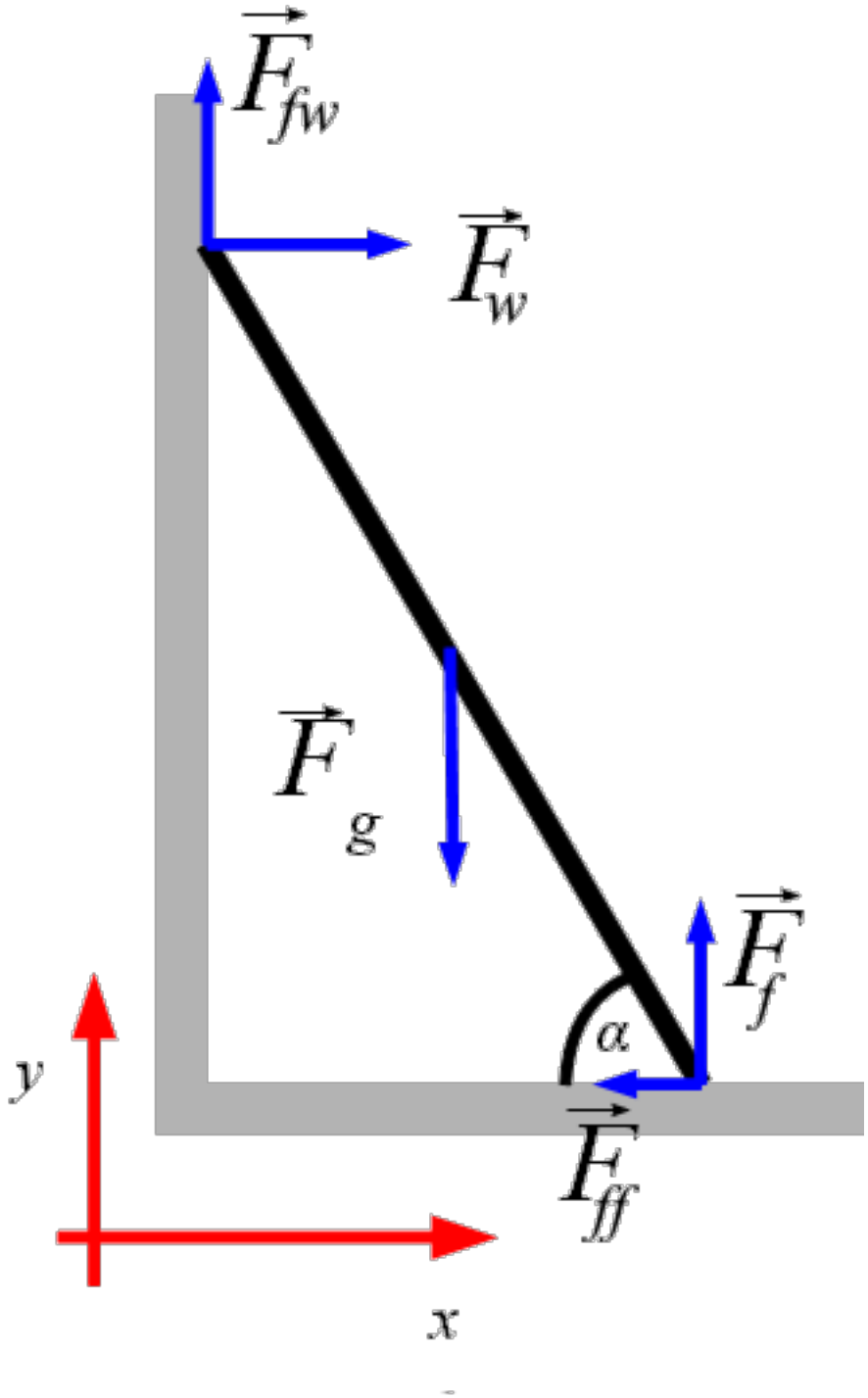
$$\frac{L}{2}F_f \sin(90^\circ - \alpha) - \frac{L}{2}F_{ff} \sin\alpha - \frac{L}{2}F_w \sin\alpha - \frac{L}{2}F_{fw} \sin(90^\circ - \alpha) = 0$$

Together with first equation this yields:

$$2F_w \sin\alpha = (F_f - F_{fw}) \cos\alpha$$

Because of wall is smooth we can assume that $F_{fw} = 0$. Hence

$$F_w = F_{ff} = \frac{F_f}{2} \cot\alpha = \frac{mg}{2} \cot\alpha = \frac{100 \cdot 9.8}{2} \cdot 3.42 \approx 142.9\, N$$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