Preparation Tests

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FYS01a: Physics 1a

This document uses LaTeX in combination with *TikZ* for typesetting.

Contents

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a)

$$F = \begin{cases} ||F|| = 15\text{N} \\ \theta_F = 45^\circ \end{cases}$$

$$\dot{v} = 0 \implies F_x = -F_f$$

$$\vec{F} = \begin{pmatrix} 15\cos\theta \\ 15\sin\theta \end{pmatrix}$$

$$\vec{F_x} = -\vec{F_f} \implies \vec{F_f} = -\begin{pmatrix} 0 \\ 15\cos\theta \end{pmatrix} \approx \begin{pmatrix} 0 \\ -10.6067N \end{pmatrix}$$

b)

Assume $g = 9.82$.

$$\vec{F_N} = \Sigma\vec{F_y} = \vec{F_g} + \vec{F_y}$$

$$\vec{F_N} = \begin{pmatrix} 0 \\ 5 \times -9.82 \end{pmatrix} + \begin{pmatrix} 0 \\ 15\sin 45^\circ \end{pmatrix}$$

$$\vec{F_N} \approx \begin{pmatrix} 0 \\ -38.493 \end{pmatrix} N$$

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3

Here, it is stated that $300N$ are required to lift a stone upwards. This means that 300 is just at the threshold where $\dot{v} > 0$.
That means that we are at a place where $\dot{v} = 0 + \frac{1}{\infty}$. This is however unsolvable, let's write it as such instead:

$$\lim_{x \to 0} (\dot{v} = x)$$

$$\lim_{x \to 0} \left(x = \frac{\begin{pmatrix} 0 \\ 300 \end{pmatrix}}{m} - \begin{pmatrix} 0 \\ -9.82 \end{pmatrix} \right)$$

$$\lim_{x \to 0} \left(x = \begin{pmatrix} 0 \\ \frac{300}{m} - 9.82 \end{pmatrix} \right)$$

$$\lim_{x \to 0} \left(x = \frac{300}{m} - 9.82 \right)$$

$$\lim_{x \to 0} (m(x + 9.82) = 300)$$

$$\lim_{x \to 0} \left(m = \frac{300}{x + 9.82} \right)$$

$$m = \frac{300}{0 + 9.82}$$

$$m = \frac{300}{9.82}$$

$$m \approx 30.550 \text{ Kg}$$

4

Assuming the center of mass is at equal distance from both arms and $g = 9.82 \mathrm{m\,s^{-2}}$:

$$\vec{F_g} = \begin{pmatrix} 0 \\ -9.82 * 53 \end{pmatrix} = \begin{pmatrix} 0 \\ -520.6 \end{pmatrix}$$

$$F_arm = \frac{||F_g||}{2} = \frac{520.6}{2} = 260.23\text{N}$$

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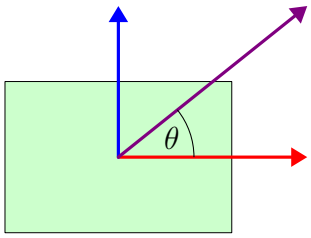
$$\vec{F}_y = \begin{pmatrix} 0 \\ ||F|| \sin\theta \end{pmatrix} \qquad \vec{F} = \begin{pmatrix} ||F|| \cos\theta \\ ||F|| \sin\theta \end{pmatrix}$$



$$\vec{F}_x = \begin{pmatrix} ||F|| \cos\theta \\ 0 \end{pmatrix}$$