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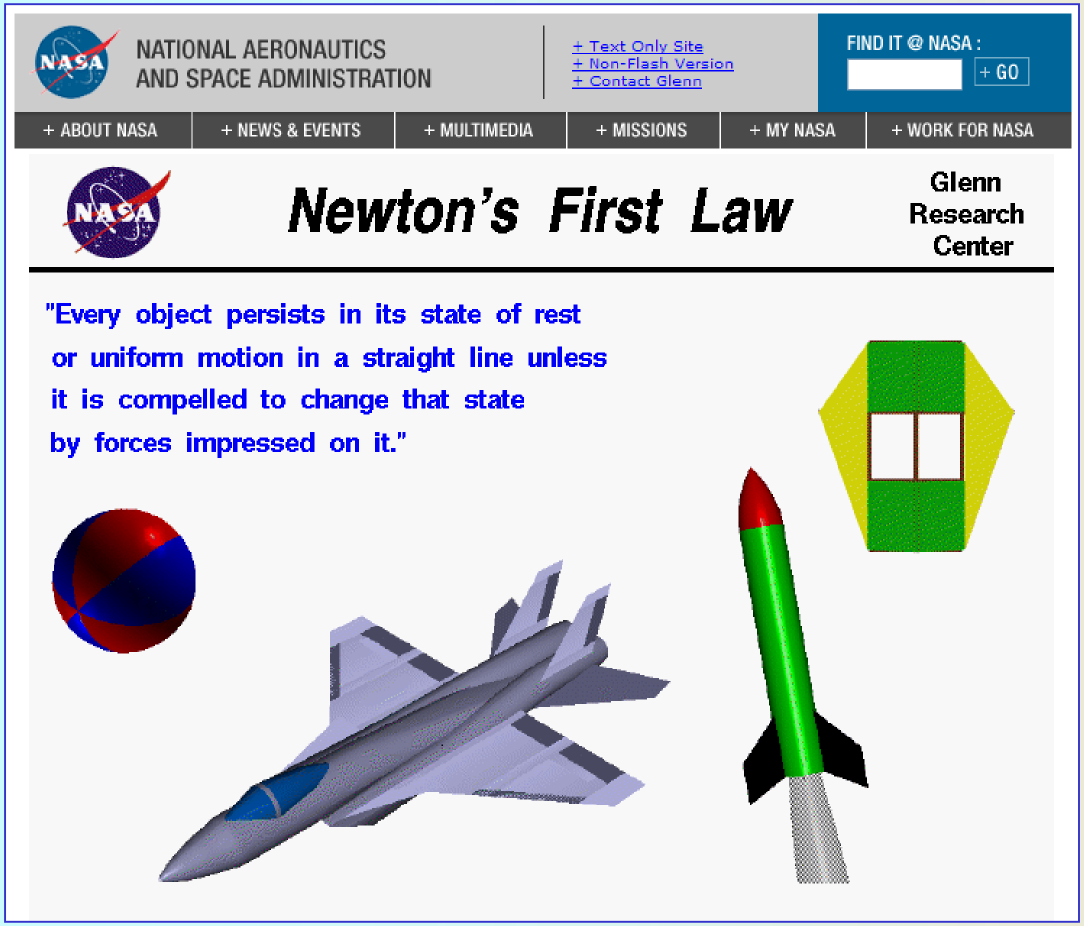
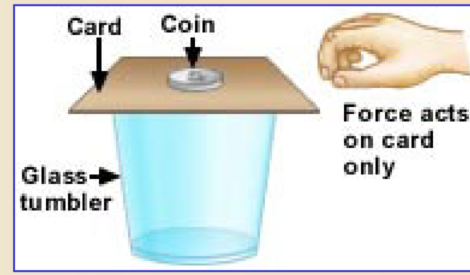
Newton's Laws

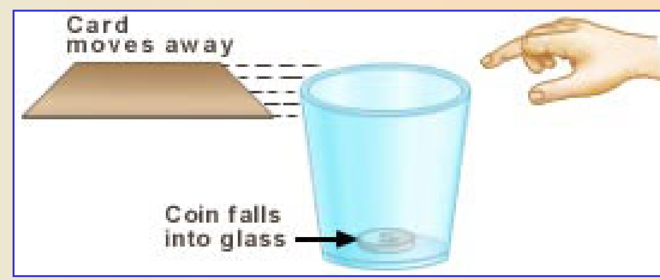


http://www.grc.nasa.gov/WWW/K-12/airplane/newton1g.html

Newton's First Law: Law of inertia

Every object continues in a state of rest, or of motion in a straight line at constant speed, unless forces are applied upon it.





http://home.att.net/~cat4a/images/newton_first_law2.jpg

$$\vec{F}_{net} = 0 \rightarrow \vec{a} = 0 \rightarrow \vec{v} = \text{const} \rightarrow \begin{cases} \text{magnitude const.} \Leftrightarrow \left|\vec{v}\right| = \text{const} \\ \text{direction const} \Leftrightarrow \alpha = \text{const} \end{cases}$$

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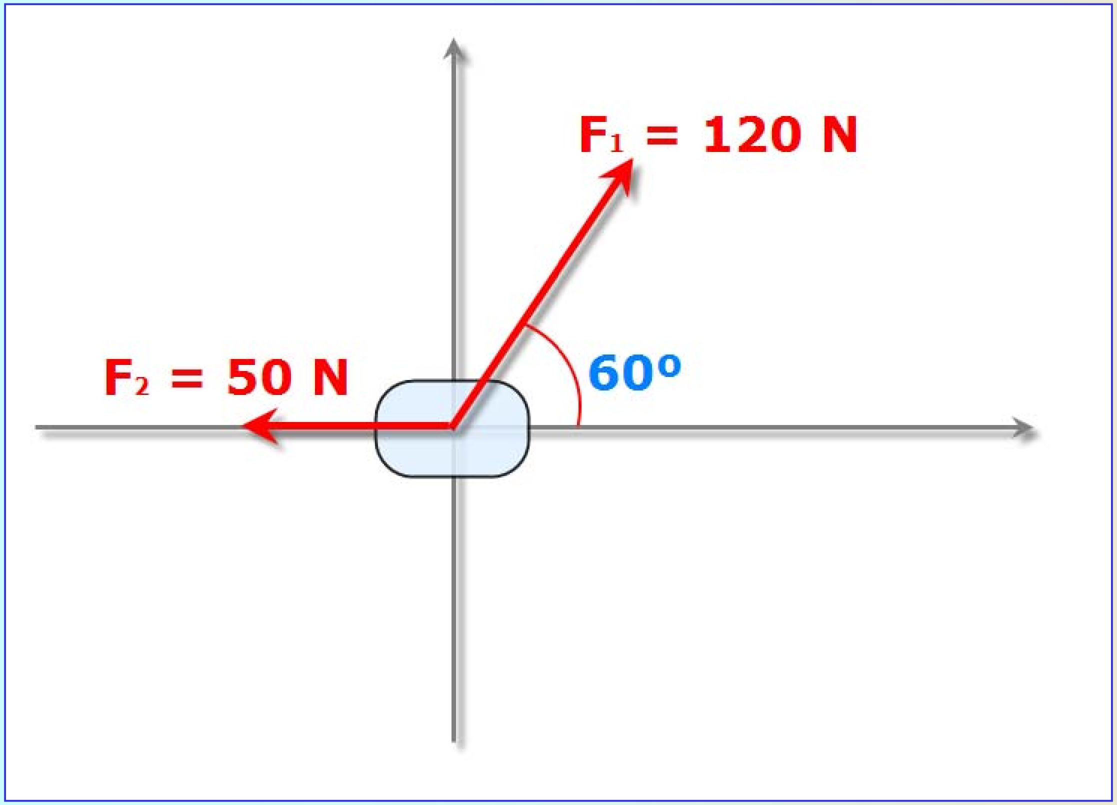

Calculate the force needed (F_3) to cancel out the effects of those two forces present in the picture

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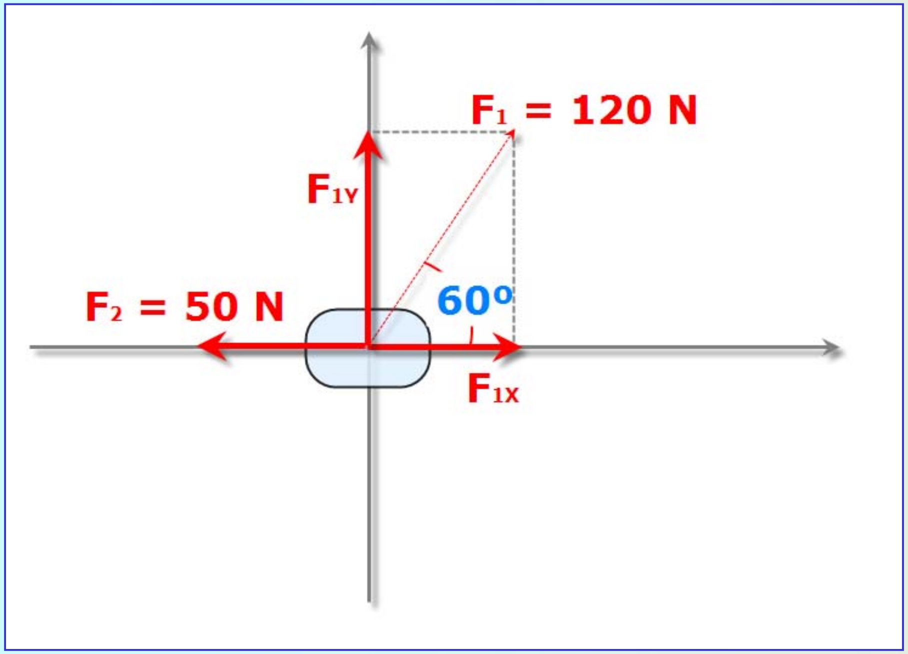

Calculate the force needed (F_3) to cancel out the effects of those two forces present in the picture

The net force is 0:

$$\vec{F_1} + \vec{F_2} + \vec{F_3} = 0$$

The components and expressions of the forces are:

$$F_{1X} = 120\ N * \cos 60^o = 60\ N$$
$$F_{1Y} = 120\ N * \sin 60^o = 103.9\ N$$
$$\vec{F_1} = 60\ N\ \vec{i} + 103.9\ \vec{j}\ (N)$$
$$\vec{F_2} = -50\ \vec{i}\ (N)$$

By substituting those values, we get F_3:

$$\vec{F_1} + \vec{F_2} + \vec{F_3} = 0$$
$$\left(60\ \vec{i} + 103.9\ \vec{j}\right) - 50\ \vec{i} + \vec{F_3} = 0$$
$$\vec{F_3} = -10\ \vec{i} - 103.9\ \vec{j}\ (N)$$
$$\left|\vec{F_3}\right| = \sqrt{(-10)^2 + (-103.9)^2} = 104.4\ N$$
$$\alpha = \tan^{-1}\frac{103.9}{10} = 180^o + 85^o = 265^o$$

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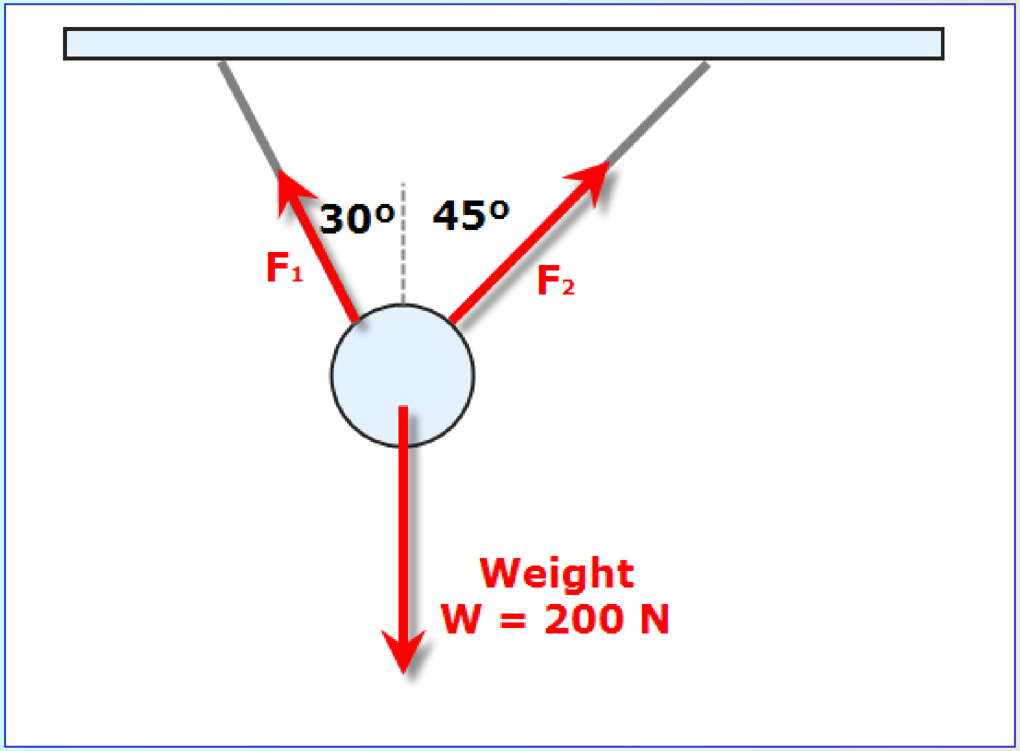

Calculate the expressions of the forces F_1 and F_2

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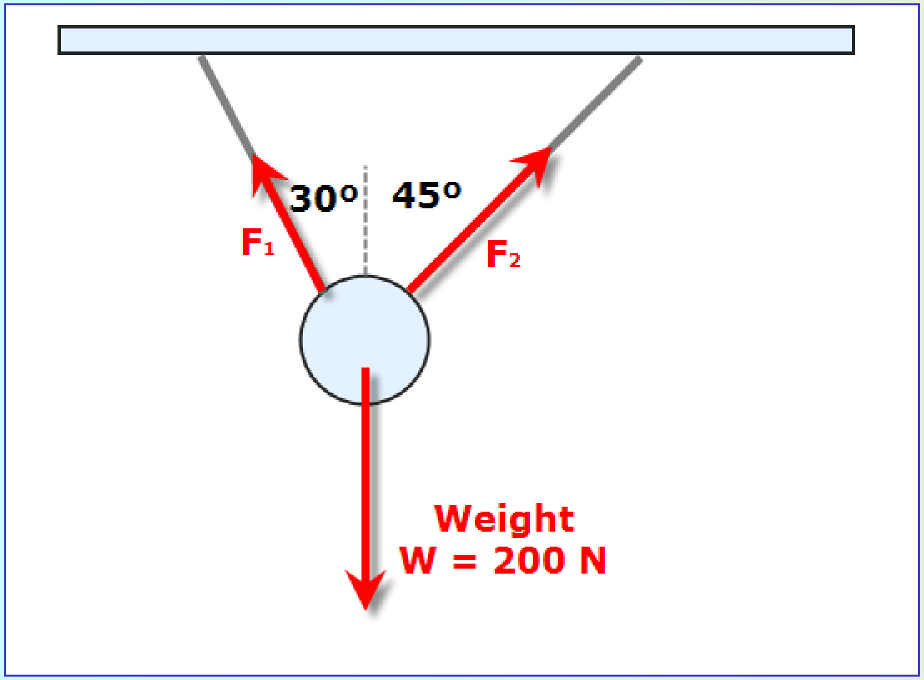
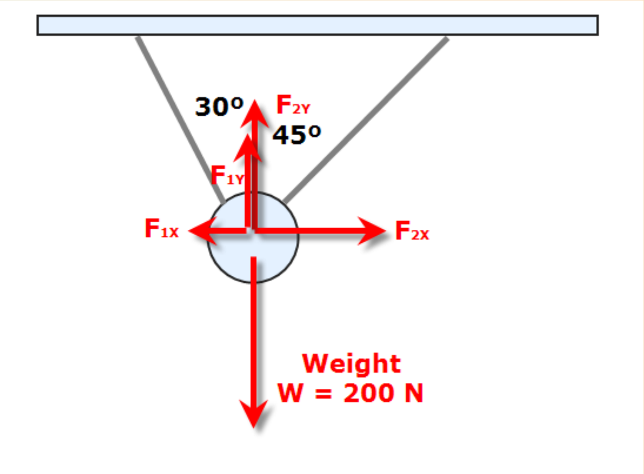


Calculate the expressions of the forces F_1 and F_2

1. Firstly, let's calculate the components of the forces:



$$F_{1X} = F_1 * \sin 30º = 0.5\ F_1$$

$$F_{1Y} = F_1 * \cos 30º = 0.87\ F_1$$

$$F_{2X} = F_{2Y} = F_2 * \frac{\sqrt{2}}{2} = 0.7\ F_2$$

2. The expressions of the forces are:

$$\vec{F_1} = -\ 0.5\ F_1\ \vec{i} + 0.87\ F_1\ \vec{j}\ (N)$$

$$\vec{F_2} = 0.7\ F_2\ \vec{i} + 0.7\ F_2\ \vec{j}\ (N)$$

$$\vec{W} = -200\ \vec{j}\ (N)$$

3. Then we apply the principle that the sum of all forces (that is, the net force) is 0

$$\vec{F_1} + \vec{F_2} + \vec{W} = 0$$

$$\left(-\ 0.5\ F_1\ \vec{i} + 0.87\ F_1\ \vec{j}\right) + \left(0.7\ F_2\ \vec{i} + 0.7\ F_2\ \vec{j}\right) - 200\ \vec{j} = 0$$

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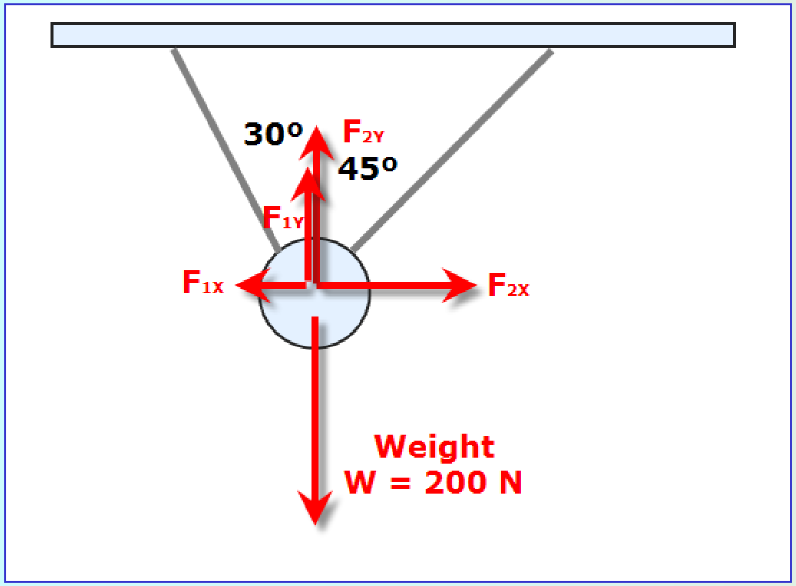

Calculate the expressions of the forces F_1 and F_2

4. If we separate components, we have a system of two equations

$$\begin{cases} -0.5\,F_1 + 0.7\,F_2 = 0 \\ 0.87\,F_1 + 0.7\,F_2 - 200 = 0 \end{cases}$$

5. We solve the system

$$F_1 = \frac{0.7\,F_2}{0.5} = 1.4 * F_2$$

$$0.87 * 1.4 * F_2 + 0.7\,F_2 - 200 = 0$$

$$F_2 = \frac{200}{1.918} = 104.3\ \text{N};\ F_1 = 146\ \text{N}$$