Newton's Law

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2/6/2023

1 Laws:

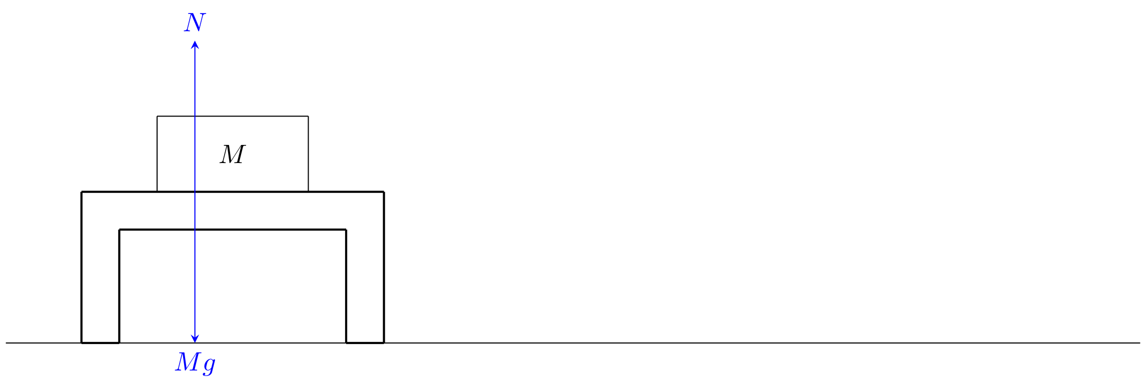
First Law:

If an object is not experiencing the effect of any force, then it will either remain stationary **or** keep moving with constant velocity.

Second Law:

If force $\vec{\mathbf{F}}$ is acting on an object with mass m, then the acceleration $\vec{\mathbf{a}}$ is given by:

$$\vec{\mathbf{F}} = m\vec{\mathbf{a}}$$



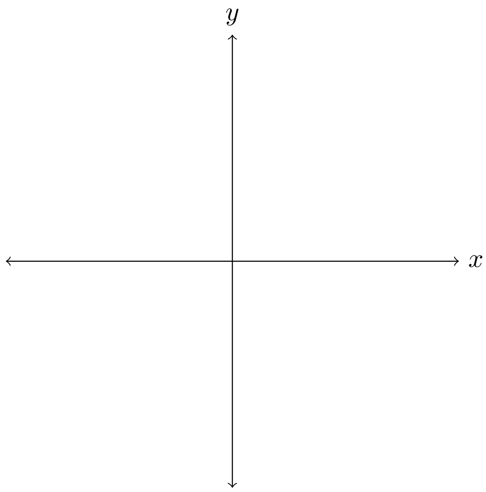
Since the book is not moving, the net forces (sum of the forces) should equal 0 N. Since the forces are vectors, the forces must act in opposite directions in order for them to cancel out. Like you can see in the above figure, the normal force N of the table acts upwards, which is opposite of the force m_g of gravity which is acting downwards.

Mathematically, this would look like:

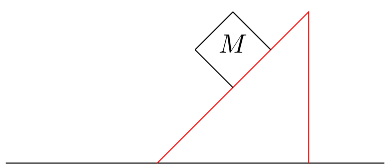
$$\sum F_{net} = N + Mg = 0\,\mathrm{N}$$

Generally speaking, **a net force of 0 N means all components of force are 0**.

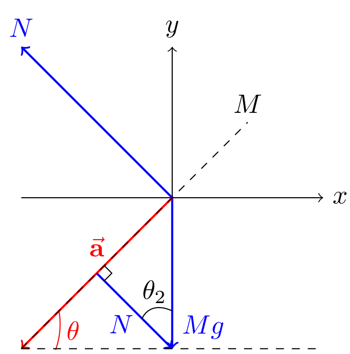
We can use free-body diagrams to model forces:



2 Example Problem



We can draw a free-body diagram to model the forces acting on the box with mass M:



Keep in mind that this diagram keeps the box in the same orientation as seen in the figure, but you could rotate the axes to match the orientation of the box, effectively making your y-axis the normal force vector N.
Using the formula $\vec{\mathbf{F}} = M\vec{\mathbf{a}}$, we can determine the formulas for the x and y components of the net force.

For the x component, we need to look at the angle θ_2 formed between the normal force vector N and gravity vector Mg. We can see that the vectors form a triangle, which allows us to use the trigonmetric functions to setup an equation in which we can solve for x.

$$\cos(\theta) = \frac{Mg}{x}$$

If the box starts from rest, how long does it take for it to come distance $l = 1$ m down the incline?