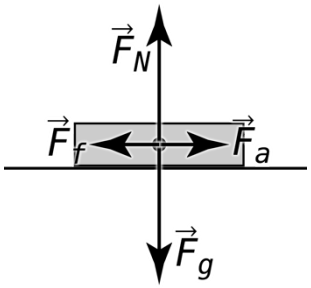
Flipping Physics Lecture Notes:
A "Show All Your Work!" Example
http://www.flippingphysics.com/show-work-example.html

A while back we had a lesson where I described why I require that you "Show All Your Work!"[1]. Today let's look at an example of something students typically want to skip, however, I require that you write down every time. A basic example of a book at rest on a level surface with a person applying a force to the right on the book.

One major step in many solutions involving this situation will include using Newton's Second Law in the y-direction like this:

$$\sum F_y = F_N - F_g = ma_y = m(0) = 0 \Rightarrow F_N - F_g = 0 \Rightarrow F_N = F_g$$

Early on in introductory physics, in many situations, force normal and force of gravity are equal in magnitude: $F_N = F_g$. Because of this many of you will assume the magnitude of the force normal and the force of gravity are *always* equal. THIS IS NOT TRUE.

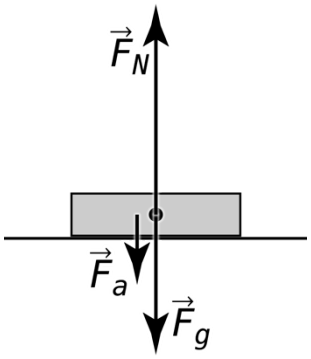


If you get into the habit of always thinking your way through and writing out the equations, you will understand when force normal and force of gravity are not equal in magnitude. There are many, many situations where this happens, however, it takes a bit of time in introductory physics to get to those situations. Some examples:

- An object in an accelerating elevator.[2]
- An object on an incline.[3]
- An object being held against a vertical wall.[4]
- When a car goes over a hill.[5]
- A painter on a scaffold.[6]

In fact, a simple example of where the force normal and the force of gravity are not equal in magnitude is if I push straight down on the book.

$$\sum F_y = F_N - F_g - F_a = ma_y = m(0) = 0$$
$$\Rightarrow F_N - F_g - F_a = 0 \Rightarrow F_N = F_g + F_a$$



[1] Why "Show All Your Work"?: http://www.flippingphysics.com/show-work.html
[2] "Do You Feel Your Weight? A lesson on Apparent Weight": https://www.flippingphysics.com/apparent-weight.html
[3] "Introductory Static Friction on an Incline Problem": https://www.flippingphysics.com/static-friction-incline.html
[4] "Dynamics Review for AP Physics 1": https://www.flippingphysics.com/ap1-dynamics-review.html
[5] "Introductory Centripetal Force Problem - Car over a Hill": https://www.flippingphysics.com/centripetal-force-problem.html
[6] "Painter on a Scaffold - Don't Fall Off!": https://www.flippingphysics.com/painter-scaffold.html