

L01 - Forces and Free-Body Diagrams

Dynamics → Unbalanced forces causing an acceleration.

Force → A push or a pull

Force is Vector quantity.

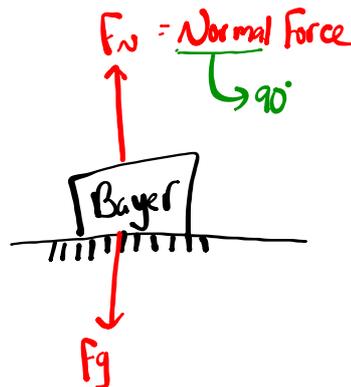
Force Magnitude is measure in the units Newtons (N).

Force Direction is measured in Degrees.

Analyzing Vectors

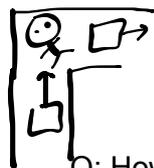
Vector Notation

F_{app} <u>Applied force</u>	F_N <u>Normal force</u>
F_f <u>Force of friction</u>	F_g <u>Force of Gravity</u>
F_{net} <u>Net (overall) force</u>	F_T <u>Force of tension</u>



forces and free-Body Diagrams

Astronauts in Space



Q: How are Astronauts able to move objects in space?

A: By applying a force.

Newton's First Law of Motion

An object will continue either being at rest or moving at constant

velocity unless acted upon by an external non-zero net force.



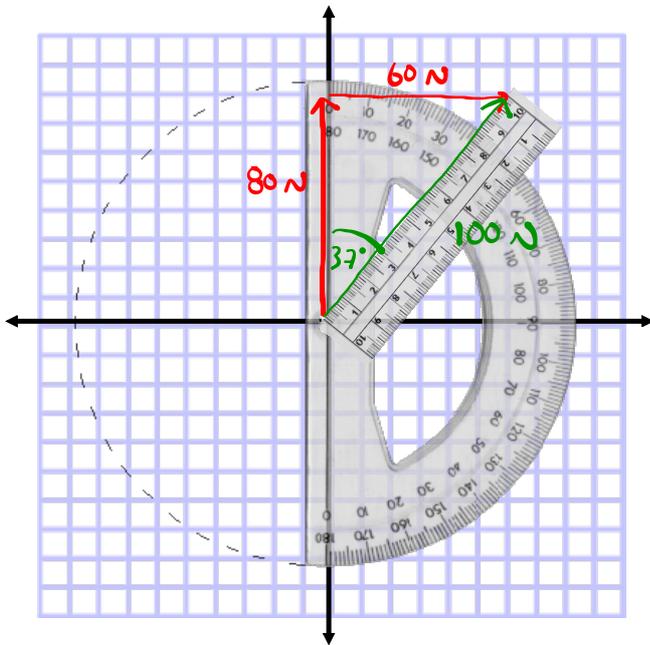
Think-Pair-Share

How does Newton's First Law of Motion relate to what we are seeing in the video...

- when an object is caught by the first astronaut?
- when an object is thrown by the first astronaut?

Adding Force Vectors Graphically

John is sitting in an initially stationary rolling chair. The chair is being pushed by Sally and Garth. If Sally is pushing with a force of 80N [North] and Garth is pushing with a force of 60N [East], what direction will John accelerate?



$$\vec{F}_{\text{net}} = 100\text{N} [37^\circ \text{ E of N}]$$

Jason thinks there might be a way to accomplish the same task with only one person pushing. At what angle, and with what force, must the lone person push the chair?

Adding Force Vectors Algebraically

Michael hates adding vectors graphically. Is there a way he can add vectors algebraically instead?

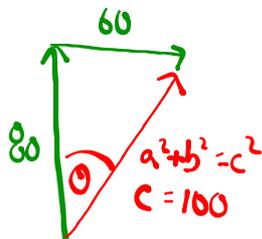
Known:

$F_1 = 80\text{N [North]}$

$F_2 = 60\text{N [East]}$

$F_{\text{net}} = \underline{\hspace{2cm}}$

	x	y
F_1 ↑	0	+80
F_2 →	+60	0
F_{net}	+60	+80

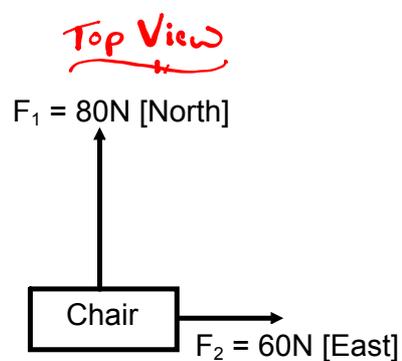
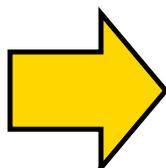


$\tan \theta = \frac{o}{a}$
 $\theta = \tan^{-1} \left(\frac{60}{80} \right)$
 $\theta = 36.87^\circ$

$\vec{F}_{\text{net}} = 100\text{N } [36.87^\circ \text{ E of N}]$

What is a Free-Body Diagram?

A vector diagram of an object in isolation showing all the forces acting on it.



Free-Body Diagram of an Object Being Pushed

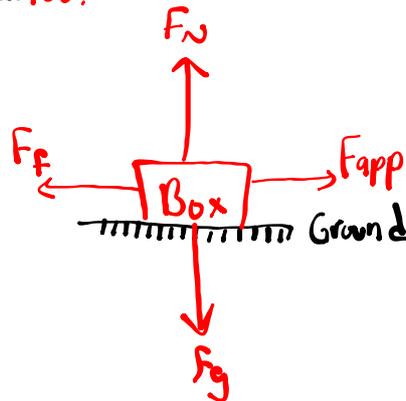
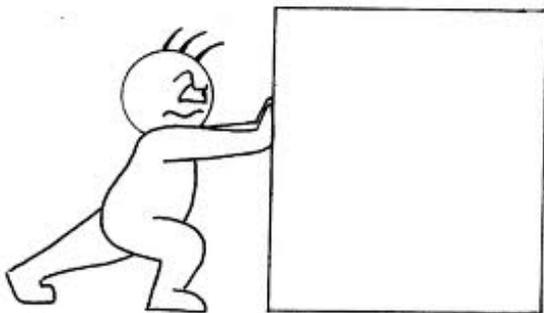
Newton's First Law of Motion

An object will continue either being at rest or moving at constant velocity unless acted upon by an external non-zero net force.

Drawing the Free-Body Diagram - Labelling Forces

Assume that the box is being pushed across rough concrete at a constant velocity.

1. What forces are acting on the object?
2. Is the box accelerating in the horizontal component? **No!** \Rightarrow **No unbalanced forces.**
3. Is the box accelerating in the vertical component? **No!**



The "Normal Force"

The force on an object that is perpendicular to a common contact surface, F_N .



Practice

Pg 131 #1-2

Pg 132 #1

Pg 133 #2

Pg 134 #2 (Solve graphically and algebraically)

