SPH3U: 3.1 Types of Forces

1. Measuring forces and force diagrams

Dynamics:	the study of the causes of motion
force	any push or pull.
newton (N)	unit for force. $1\ N = 1\ kg \cdot m/s^2$
measuring forces	spring scales or force sensors.
① system diagrams	a simple sketch of all objects in a situation
② free-body diagrams (FBDs)	a simple drawing of one object showing all forces on it.

① System diagram

② FBD

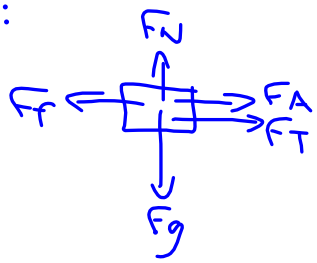
2. Everyday forces

$\vec{F}_a$ $\vec{F}_T$ $\vec{F}_N$ $\vec{F}_f$ $\vec{F}_g$

Applied force:	a force caused by an object pushing or pulling.
Tension:	a rope or string pulling an object. (no push)
Normal force:	when a surface pushes back on an object. $\vec{F}_N$ is always perpendicular to the surface.
Friction:	always tries to stop motion. acts in the opposite direction of motion.
Gravity:	force of attraction between any 2 objects. $\vec{F}_g = m\vec{g}$, where $\vec{g}$ is $9.8\ m/s^2$ [down].

System

FBD:



Draw both the system diagram and the FBD for each object in italics.

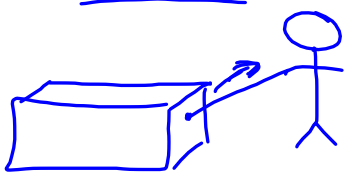
a. A *cup* is sitting at rest on a table.

System:

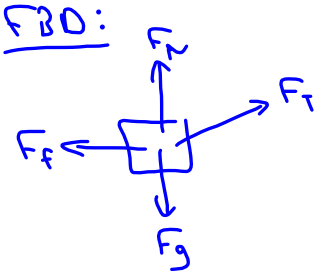
FBD:

b. A large *trunk* in the basement is pulled by a rope tied to the right side of the trunk by a person. The trunk does not move.

System:

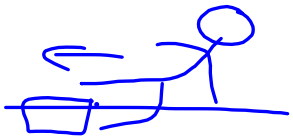


FBD:

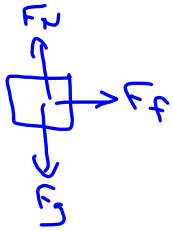


c. A *baseball player* is sliding to the left across the ground.

System:

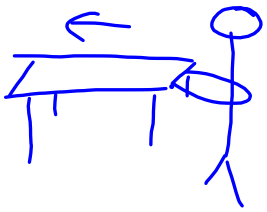


FBD:

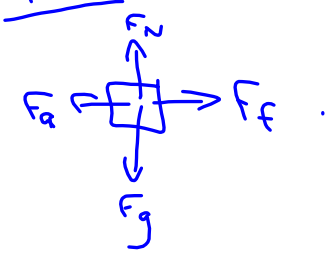


d. A *desk* is pushed to the left across the floor.

System:



FBD:



3. Calculating net forces

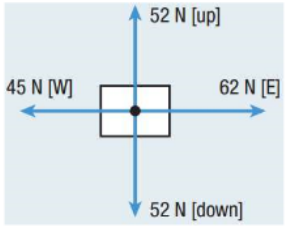
Net force: $\vec{F}_{Net}$	total force. the sum of all forces acting on an object. (2d vector addition).

The floor exerts a normal force of 36 N [up] on a stationary chair. The force of gravity on the chair is 36 N [down]. Draw the FBD of the chair and use the FBD to determine the net force on the chair.

$\vec{F}_{Net} = \vec{F}_N + \vec{F}_g = 36\,N\,[u] + 36\,N\,[d]$
$= 36\,N\,[u] - 36\,N\,[u]$
$= 0\,N$

$\therefore$ the net force is 0 N!

The figure to the right shows all the forces acting on an object. Use the FBD to calculate the net force.



$\vec{F}_{Netx} = 62 - 45$
$= 17\,N\,[E]$

$\vec{F}_{Nety} = 52 - 52$
$= 0\,N.$

$\therefore \vec{F}_{Net} = 17\,N\,[E].$

4. Four fundamental forces

Gravitational:	acts between any 2 objects. only attractive (only pulls, no push)
Electromagnetic:	caused by electric charges. Can attract or repel (push or pull). Holds atoms and molecules together. } almost all forces are electromag.
Strong nuclear:	holds the nucleus together. keeps the protons from repelling each other, and from getting too close to each other.
Weak nuclear:	holds a single proton or neutron together (binds the quarks together).

Type of force	Approximate relative strength	Range	Effect
gravitational	1	∞	attract only.
electromagnetic	10^{20}	∞	attract and repel
strong nuclear	10^{38}	$< 10^{-15}$ m	↓
weak nuclear	10^{25}	$< 10^{-18}$ m	↓

Homework: page 122: #1-2, 5, 7, 13, 15