

Introduction to Mechatronics Terms

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Outline

Where are we going today?

- Mass
- Acceleration/Velocity
- Force
- Torque
- Work/Power/Energy

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his may or may not be physics review for you. If it is, skim through, make sure you're comfy. If not, let this be a fun first foray!

Mass

Sitting around like a bump on a log

- Mass is "how much stuff is there?"
- Not weight, but we commonly correlate the two on earth
 - (ignoring buoyancy) things of the same mass weigh the same in a constant gravitational field

Examples

- Kilograms (kg)
- Slugs (slug)
- Pounds-mass (lbm)

Warning

Pounds-Mass is not the same unit as Pounds-Force!

Velocity and Speed

Gotta go Fast!

- Speed is how fast something is going- a scalar quantity
 - Scalar quantity
 - "Travelled 60 miles in one hour"
- Velocity is how fast something is going in a direction
 - Vector quantity
 - "Travelling 30 MPH, Northeast"

Examples

- Miles per Hour (mph)
- Meters per Second (m/s)

Warning

Rotational speed / velocity are different quantities. We'll get there!



Acceleration

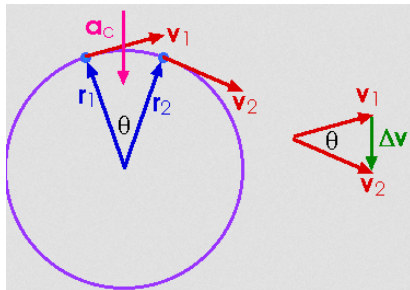
A thrill better than speed!

Acceleration is how fast your velocity is changing.

If you accelerate from 30 ft/s to 10 ft/s in 4 s, that's

$$a = \frac{\Delta v}{\Delta t} = \frac{10 \text{ ft/s} - 30 \text{ ft/s}}{4 \text{ s}} = -5 \frac{\text{ft}}{\text{s}^2}$$

Note: direction matters! You can have acceleration perpendicular to your movement. In the case of circular motion, this is known as centripetal acceleration. The tread of a spinning tire is always accelerating inwards.



Force

May the rate of change of momentum for a closed system be with you.

A long while ago, this fellow Newton had an idea: what if objects interacted with each other via forces? Turns out, it's at least a really good model.

Principle 1 - Proportionality

The net force on an object causes acceleration inversely proportional to its mass.

$$\sum \vec{F} = m\vec{a} \quad (1)$$

Principle 2 - Reciprocity

When a force is imposed upon object A by B, B sees a force of equal magnitude and opposite direction.

$$[\sum \vec{F}]_{universe} = 0 \quad (2)$$