Lecture 1

Newton's laws of motion

Newton's first law: every body continues in its state of rest, or of uniform motion in a right line, unless it is compelled to change that state by forces impressed upon it

not intuitive because it looks like the state of rest is the preserved state of motion

this is the case because there is friction in the world

Newton's second law: a force will cause an object of mass to accelerate $\vec{F}=m\vec{a}$

Newton described the second law in term of impulse—$\vec{F}\Delta t=\Delta \vec{p}$

Is $\vec{F}=m\vec{a}$ always the same as $\vec{F}\Delta t=\Delta \vec{p}$

They are the same if the mass of the object is constant

An example of when the mass of the object is changing is a rocket that is losing fuel

Newton's third law: to every action there is always opposed an equal reaction: or, the mutual action of two bodies upon each other are always equal, and directed to contrary parts

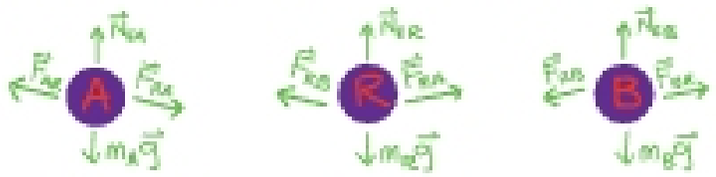
Action-reaction pair of forces cannot act on the same body; they act on different bodies

$\vec{F}_{2,1} = -\vec{F}_{1,2}$

$\vec{F}_{1,2}$ = force on object 2 due to interaction between objects 1 and 2

Group activity: string theory

A pair of two people pill on the opposite ends of a string



Are $\vec{N}$ and $m_E\vec{g}$ third law interaction pairs? No, they are on the same object so they cannot be interaction pairs The earth is acting two ways on one object.

A large truck collides head-on with a small car. During the collision...

a) the track exerts a greater force on the car than the car exerts on the truck

b) the car exerts a greater force on the truck than the truck exerts on the car

c) the truck exerts the same force on the car as the car exerts on the truck

d) the truck exerts a force on the car but the car does no exert a force on the truck

Superposition principle $\vec{F}_3 = \vec{F}_1 + \vec{F}_2$

$\hat{i}$	$\hat{j}$
70	20
-30	40
-40	-60

$\vec{F}_3 = -40\hat{i}-60\hat{j}$ $F_3=\sqrt{(-40)^2+(-60)^2}=72.1$

$\theta = \tan^{-1}(\frac{-60}{-40}) = 56.3°$ SW

Vector decomposition

Three forces are acting on an object that is at rest

Two of those forces are $\vec{F}_1 = 70\hat{N}i + 20\hat{N}j$ and $\vec{F}_2 = -30\hat{N}i + 40\hat{N}j$

Force: physics laws, free body diagrams

Mass times acceleration: mathematical description $\vec{F}_{net} = m\frac{d^2\vec{r}}{dt^2}$

An object goes from one point in space to another. After the object arrives at its destination, the magnitude of its displacement is either smaller than or equal to the distance traveled