

# Physics 200

Quiz 1.0? Topic?

Forces

Newton's Laws

Day #6  
Sept 18<sup>th</sup>

5 vector add/conversion

3 1-D const. accel.

18 2-D projectile motion

Wed 20<sup>th</sup>

Monday 25<sup>th</sup>

Wed. 27<sup>th</sup>

4

many

0

## Forces

are vectors

act between two objects

feels like a push or pull

Can be long range (gravity, magnetic)

or contact (friction, air resistance)

many types

Newton's Laws: (3)

1. Velocity is constant. Unless acted on by external force.

2.  $\sum \vec{F} = m\vec{a}$  of mass  $m$

↑ Sum of all forces acting on mass  $m$

$$3. \vec{F}_{\text{on A due to B}} = - \vec{F}_{\text{on B due to A}}$$

Units: mass: kilogram (kg) = 1000 grams

force: Newton (N) =  $\text{kg} \frac{\text{m}}{\text{s}^2}$

The "SI" unit system also called: mks A  
meter kilogram second Amp

hour

1<sup>st</sup> order of minute-ness =  $\frac{1}{60}$  hour  
= the minute

2<sup>nd</sup> order of minute-ness =  $\frac{1}{60} \cdot \frac{1}{60}$  hour  
= second

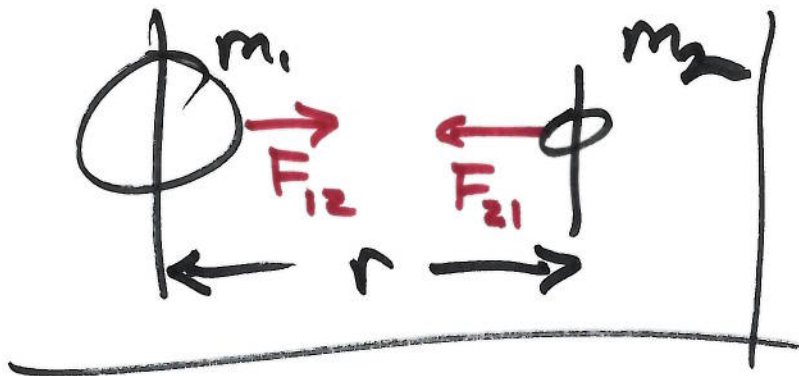
List of forces

gravity, near Earth  $F_g = mg$  "down"

Gravity, universal,  $F_G = G \frac{m_1 m_2}{r^2}$   $G = 6.7 \times 10^{-11} \frac{\text{Nm}^2}{\text{kg}^2}$

Normal force,  $F_N$ , just big enough  
to prevent one solid moving into  
another solid.  
Perpendicular to surface.





Friction: opposes sliding (slipping)

simple model of friction:

Kinetic friction: when it's sliding

$$F_{fk} = \mu_k \cdot F_N$$

↑ coefficient of friction

greek lower case "u"

name of letter is "mu"

$$F_{fs} \leq \mu_s F_N \Rightarrow \mu_s$$

↑ static - No slipping (yet)

$\mu_s > \mu_k$  harder to get things moving than to keep them going.

$\mu$  is property of both surfaces  
(your shoe on wet concrete).

air resistance

$$\vec{F}_{\text{air}} = -b \vec{v}$$

↑ maybe  $v^2$

rolling friction is (generally) small

$$F_{f_r} = \mu_r F_N$$

↑ small... but depends on conditions.

$\mu$  has no units.