

# Lecture Notes 9/16

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• Atoms, Forces, Light, Gravity, Motion •

Forces = any force has to come down to one of these 4 things:

- Gravity = keeps universe in shape it's in. Always attractive
- Coulomb = electrical force Attractive / Repulsive
- Strong Nuclear = keeps protons in atom from all coming apart
- Weak Nuclear = radio active decay

★ In astronomy we deal primarily with the gravitational force ★  
• Gravity does not affect photons @ rest.

• Newton's Law of Motion •

- Describe and Predict motion -

① An object @ rest stays @ rest. . .

②  $F = ma$  (the formula)

(inertial frame of reference) The amount of acceleration ( $a$ ) that a force ( $F$ ) can produce depends on the mass ( $m$ ) of the object being accelerated.

③ For every force there is an equal and opposite force,  
ie. action and reaction occur as a pair.

• Control everything seen in Heaven ↑ Newton's Laws

inertial — non-accelerating

1. Definition = Accelerating - change in speed or change in direction
2. Cause = Apply force to something → cause Acceleration
3. Equal / opposite force

Anytime there's unbalanced forces → yield an acceleration  
Balanced forces are the same as no forces

## Describing Motion

- Kinematics - how things move
- Dynamics - why things move
  - vectors - has both magnitude and direction
  - ↳ acceleration

## Most common vectors:

- displacement = The distance and object move and its direction (Ex. 3M towards the car)
- velocity = distance per unit time (55 Mph East)
- acceleration
- force

## Centripetal Forces

- Newton's 1st law = Some force active on the planets
- influence of centripetal force.

- Newton's laws only work with Inertial frames of Reference

## Gravity and Motion

Gravity is what affects all objects

## Inertia

Tendency of an object to obey Newton's 1st law

Central to Galileo's laws of motion is the concept of inertia.

Inertia - tendency of a body @ rest to remain @ rest and a body in motion to keep moving.

Ex. Apply the brakes of your car suddenly, and the inertia of the bag of groceries beside you keeps the bag moving forward at its previous speed until it hits the dashboard or spills onto the floor.

Newton recognized the importance of inertia - described it in his laws.

= A body continues in a state of rest or uniform motion in a straight line unless acted to change that state by forces acting on it.

Acceleration - any change in speed - nonuniform motion.

Uniform Motion - speed of car remains the same.

Newton's Law of Gravity

Every mass exerts a force of attraction on every other mass. The strength of the force is directly proportional to the product of the masses divided by the square of their separation.

$$F = \frac{GMm}{r^2}$$