Chapter 3

Newton’s Law

Newton's Laws

- Newton's First Law
  - Law of Inertia
- Newton's Second Law
  - **F** = m**a**
- Newton's Third Law
  - Action Reaction
- Law of Universal Gravitation

$$F = \frac{Gmm'}{r^2}$$

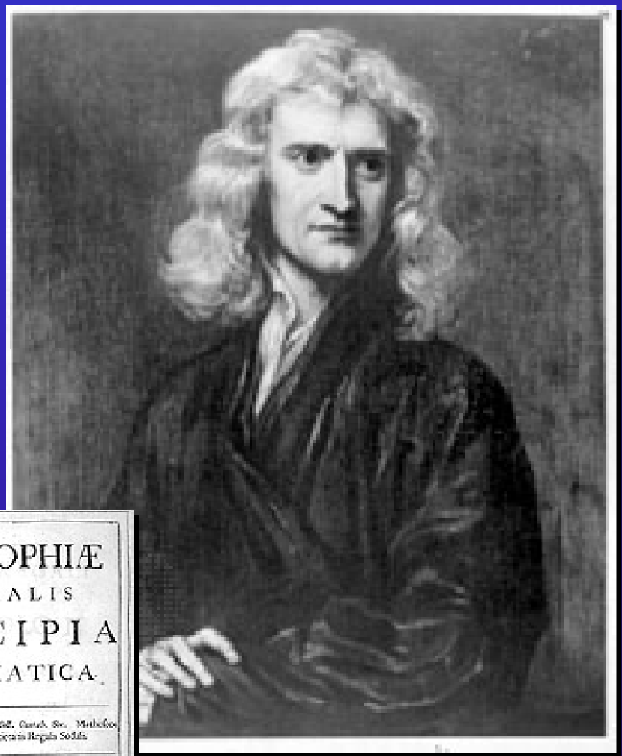
Mass

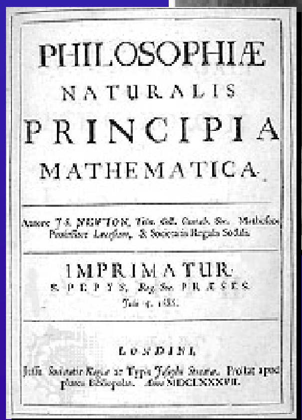
- …is measured in kilograms.
- …is the measure of the inertia of an object.
- Inertia is the natural tendency of a body resist changes in motion.

Force

- ☞ …the agency of change.
- ☞ …changes the velocity.
- ☞ …is a vector quantity.
- ☞ ...measured in Newton's.

Newton’s First Law





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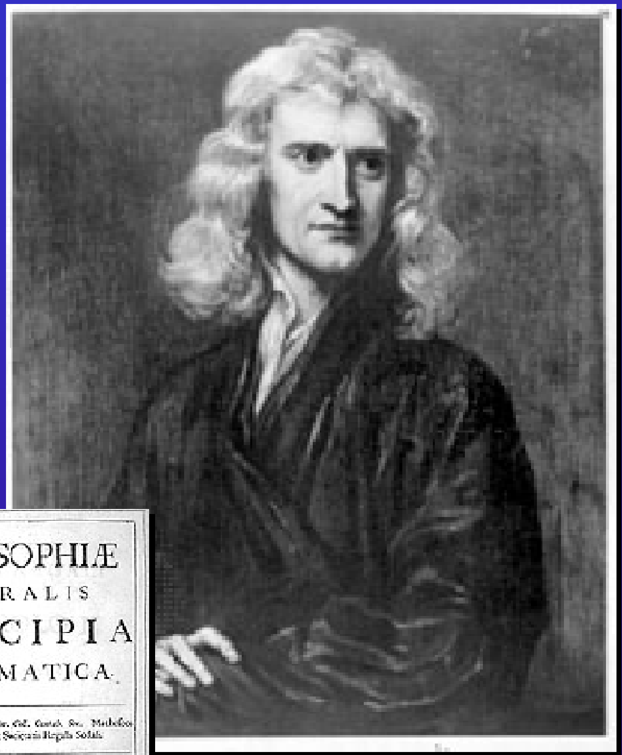
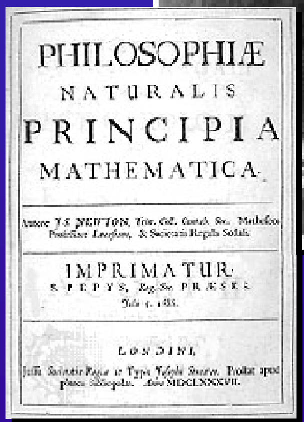
- Law of Inertia
- “A body remains at rest or moves in a straight line at a constant speed unless acted upon by a force.”

Newton's First Law

- No mention of chemical composition
- No mention of terrestrial or celestial realms
- Force required when object changes motion
- Acceleration is the observable consequence of forces acting

Newton's Second Law





The Sum of the Forces acting on a body is proportional to the acceleration that the body experiences

$$\Sigma \mathbf{F} \propto \mathbf{a}$$

$$\Sigma\ \mathbf{F} = (\text{mass})\ \mathbf{a}$$

$$\vec{F} = m\vec{a}$$

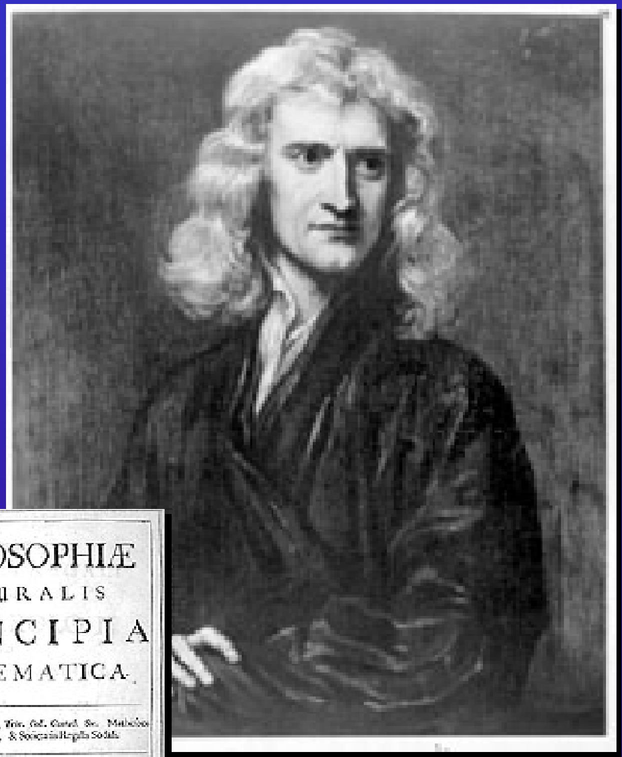
Net Force

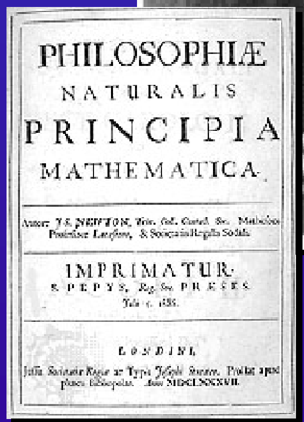
$$\sum F_x = ma_x$$

$$\sum F_y = ma_y$$

$$\sum F_z = ma_z$$

Newton’s Third Law





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LONDINI,

- Action-Reaction
- For every action force there is an equal and opposite reaction force

The Law of Gravity

- Every mass exerts a force of attraction on every other mass.
- The math…

$$F = \frac{Gmm'}{r^2}$$

- $G = 6.67 \times 10\text{-}11\ \ N \cdot m^2/kg^2$

Gravity Questions

- Did the Moon exert a gravitational force on the Apollo astronauts?
- What kind of objects can exert a gravitational force on other objects?

Gravity Questions

- The constant G is a rather small number. What kind of objects can exert strong gravitational forces?

- If the distance between two objects in space is doubled, then what happens to the gravitational force between them?

Weight

- The weight of an object F_W is the gravitational force acting downward on the object.

- $F_W = m\,g$

Tension
(Tensile Force)

- ☞ Tension is the force in a string, chain or tendon that is applied tending to stretch it.

- ☞ F_T

Normal Force

- The normal force on an object that is being supported by a surface is the component of the supporting force that is perpendicular to the surface.
- F_N

Coefficient of Friction

☞ Kinetic Friction

- $F_f = \mu_k F_N$

☞ Static Friction

- $F_f \leq \mu_s F_N$

☞ In most cases, $\mu_k < \mu_s$.


On to problems...