Newtonian Gravitation

Grade 12 Physics

Newton's Universal Gravitatio

Philosophiae Naturalis Principia Mathematica aka.

Everything is all based on an APPLE

Good stuff~!!!

Newton's Universal Gravitatio

- Formula

$$F_g = G\frac{m_1 m_2}{r^2}$$

$$G = 6.67 \times 10^{-11}\ \frac{\mathrm{N \cdot m^2}}{\mathrm{kg^2}}.$$

Quantity	Symbol	SI unit
force of gravity	F_g	N (newtons)
first mass	m_1	kg (kilograms)
second mass	m_2	kg (kilograms)
distance between the centres of the masses	r	m (metres)
universal gravitational constant	G	$\frac{\mathrm{N \cdot m^2}}{\mathrm{kg^2}}$ (newton · metre squared per kilogram squared)

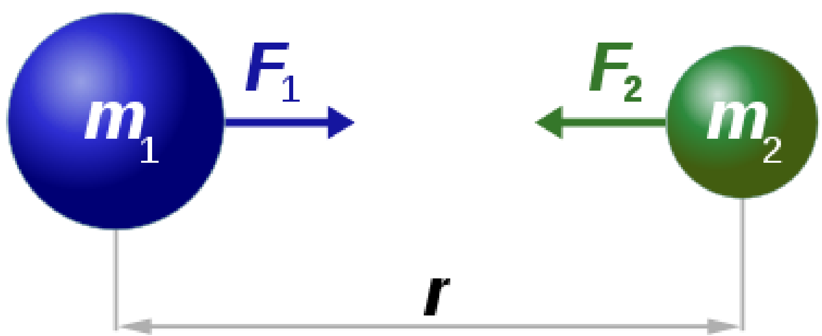
Gravitation

Universal Gravitation

$$F = \frac{Gm_1m_2}{r^2}$$

G = universal gravitation constant

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



$$F_1 = F_2 = G\,\frac{m_1 \times m_2}{r^2}$$

Gravitation

- Universal Gravitation Example
  - The gravitational force indicated here is a vector product.

Gravitation Fields

Universal Gravitation

By knowing the mass of Earth: **5.97×1024 kg** and the ra

$$F = ma$$

$$F = \frac{Gm_1m_2}{r^2}$$

Gravitation

Universal Gravitation

$$m_2 = \text{ mass of object } = m$$

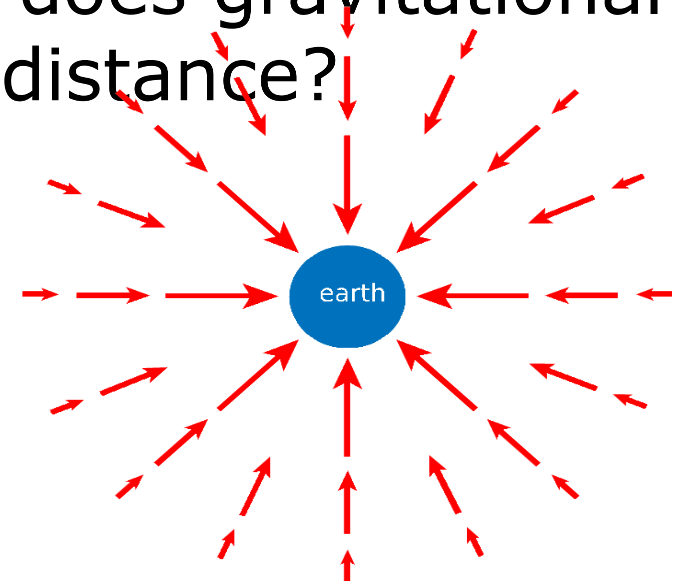
$$m_1 = \text{ mass of earth}$$

$$F = \frac{Gm_1}{r^2} m$$

$$\frac{Gm_1}{r^2} = \frac{6.67 \times 10^{-11} \square 5.97 \times 10^{24}}{\left(6.37 \times 10^6\right)^2} = 9.81$$

Gravitation Fields

Thus, the gravitational field strength at a distance r from a body of mass m equals to the magnitude of gravitional acceleration at that distance : g=Gm/ r^2How does gravitational field strength change with distance?



Group Problem

- EX1:
  - A 65.0kg astronaut is walking on the surface of the Moon,

Group Problem

- EX2:
  - How far apart would you have to place two 7.0kg bowling

Circular Orbits and Orbital Velocity

Gravitational and Centripetal Force

Orbital Velocity

The orbital velocity is the velocity required for an object to reach an orbital path without falling back to the Earth.

For example: *a man made satellite orbits around the Earth.*

Gravitational and Centripetal

The orbital velocity can be determined by assuming that w

$$\frac{G m_o M_E}{R_E^{\,2}} = \frac{m_o v_{orbit}^2}{R_E}$$

Gravitational and Centripetal

Orbital Velocity

$$\frac{G m_o M_E}{{R_E}^2} = \frac{m_o v_{orbit}^2}{R_E}$$

$$v_{orbit} = \sqrt{\frac{G M_E}{R_E}}$$