Fg, the real deal*

Friday, April 19, 2013 9:19 AM

Fg exists between any two masses and is given by:

$$F_g = \frac{G m_1 m_2}{r^2} \qquad G = \overbrace{6.67\times10^{-11}\ N\frac{m^2}{kg^2}}^{\text{Universal Gravitational Constant}}$$

$$= 6.67\times10^{-11}\left[\frac{60\,(5.98\times10^{24})}{(6.38\times10^{6})^2}\right] = 588\,N$$

$$F_g = \boxed{\frac{G m}{r^2}}$$

Fg on Earth' surface on a 60 kg mass: $F_g = (m)(g)$

This force holds object in (approximately) circular orbits.

$$ISS = 9 \approx 9 \frac{N}{kg}$$

g is called: the GRAVITATIONAL FIELD STRENGTH a gravitational field is the bending of space-time by a mass.

$$\vec{g} = \frac{G m}{r^2} \quad \text{on } \underline{\text{Earth}} = 9.8\frac{N}{kg}$$

$$\vec{g}_{moon} = 6.67\times10^{-11}\left(\frac{7.35\times10^{22}}{(1.74\times10^{6})^2}\right) = 1.62\frac{N}{kg}$$

$$\frac{m}{s^2}$$

Find F_g Earth → moon
$= 1.98\times10^{20}\,N$

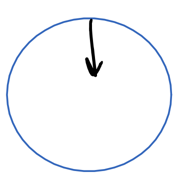
radius E→M
$= 3.84\times10^{8}\,m$

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

The moon orbits the Earth, we can use this
To find the mass of the Earth

$$F_c = F_g$$

geo → Earth
Syn → same
chronous → Time



Prove there is ONLY one radial distance from the Earth which allows for geosynchronous orbit.

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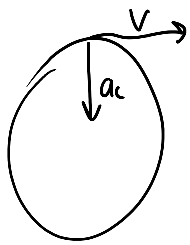
$$4\pi^2 r f^2 = \frac{G m_1 m_2}{r^2}$$

$$\frac{4\pi^2 r^3}{G m_1 m_2} = T^2$$

In orbit there is no surface that objects rest upon, this means that Fn = 0N

GEOSYNCHRONOUS (geostationary)



Apollo 13

When in orbit an object is constantly
Accelerating toward the middle of circle, it is "freely falling" at $a_c = g$

When free falling objects have ~~apparent~~ effective weight $\boxed{(Fn) = 0}$ vomit comet

What is the apparent weight of an astronaut in orbit in the ISS?

$\vec{g}$ of Jupiter is $\approx 25 \frac{N}{kg}$

Find the gravitational field ($\vec{g}$) at 4x Jupiter's radius. $r_{Jupiter} = 70\ Mm$.

70,000,000 m

$$\vec{g} = \frac{Gm}{r^2}$$

$$25 = \frac{6.67\times10^{-11}\ m}{(4r)^2}$$

$\hookrightarrow 16$

decrease by $\frac{1}{16} \rightarrow \frac{1}{4^2}$

Find the gravitational field strength at a HEIGHT of 3.0×10^{6} m above Earth's surface.

$$\vec{g} = \frac{Gm}{r^2} = \frac{6.67 \times 10^{-11}(5.98 \times 10^{24})}{(\underbrace{6.38 \times 10^{6} + 3.0 \times 10^{6}}_{\hookrightarrow r})^2}$$

$$= \underbrace{4.53}_{\hookrightarrow g} \frac{N}{Kg}$$

Determine the orbital velocity at that HEIGHT!!!

$$F_c = F_g$$

$$\cancel{m} a_c = \cancel{m} g$$

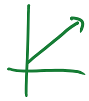
$$\frac{v^2}{r} = g$$

$$v = 6.52 \times 10^{3}\ m/s$$

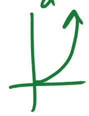
$$= 6.5\ km/s$$

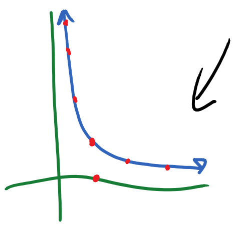
Inverse Square Law

$F_e = kx$



$d = at^2/2$





$\vec{g}$ @ Earth's Surface $= 9.8$

$$= \frac{Gm}{r^2}$$

Find $\vec{g}$ @ 2 Earth radii from center.

$$\frac{Gm}{(2r)^2}$$

3 Earth radii

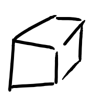
$$\vec{g} = \frac{Gm}{(3r)^2}$$

$\hookrightarrow g$

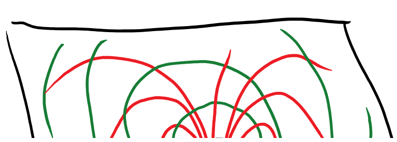
Thomas:

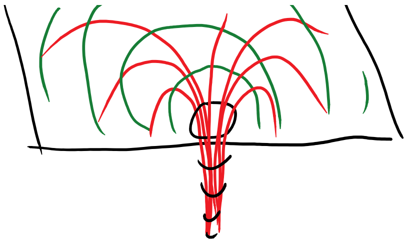
"I could be the first man to never come out of a black hole."

Penrose



"Beyond your imagination."





imagination.

Big Z Sun.

Fast ≈ 10%

An exoplanet has gravitational field strength
Of 36 N/kg at its surface, what is g at a HEIGHT of
5 radii

$= \frac{Gm}{r^2}$

10^{10} D5

1 +