Newtons Law of Universal Gravitation

Wednesday, October 30, 2019 9:04 AM

There is a force of gravity between all masses. Given by the formula

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

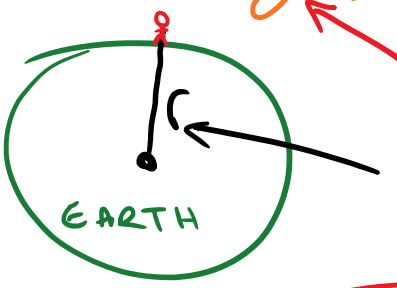
$G = 6.67 \times 10^{-11} \frac{N m^2}{kg^2}$

m_1 = mass object 1

m_2 = mass object 2

d = distance between centres

often → use radius of a planet



If the mass of Earth is 5.98×10^{24} kg and radius of Earth is 6.38×10^{6} m find the force of gravity between Earth and a 10 kg cat.

$$F_g = \frac{G m_1 m_2}{d^2} = \frac{6.67 \times 10^{-11} (5.98 \times 10^{24}) 10}{(6.38 \times 10^6)^2} = 98\ N$$

Gravitational Field: ← masses bend the universe

g = gravitational field

amount of bending = gravitational field

$$g = \frac{G m}{d^2}$$

$\frac{9.8}{2^2}$

What would g be at double the radius of the earth? $g = \frac{G m_e}{(2 r_e)^2}$

$$\frac{6.67 \times 10^{-11} (5.98 \times 10^{24})}{(2 \times 6.38 \times 10^6)^2} = 2.45 \frac{N}{kg}$$

$$g_{surface} = \frac{6.67 \times 10^{-11} (5.98 \times 10^{24})}{(6.38 \times 10^6)^2} = 9.8 \frac{N}{kg}$$

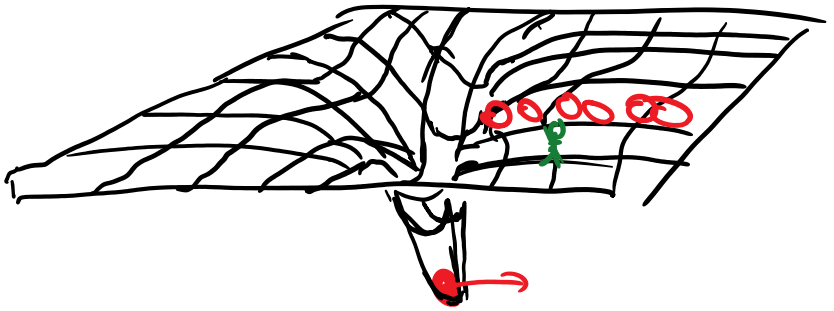
A Mars' surface $g = 3.4 \frac{N}{kg}$, what is g at 3 Mars radii?

google m_{mars} r_{mars}

$\frac{3.4}{3^2} = 0.38 \frac{N}{kg}$

$\frac{3.7}{3^2} = 0.38$ kg 1 mars

At some point from Jupiter $g = 8.0 \frac{N}{kg}$ if you measure g at $\frac{1}{2}$ that distance what will you get?



2 cats on fire have a force of gravity 8.0×10^{-10} N between them. The distance between is doubled, what's new F_g?

$$\frac{8.0 \times 10^{-10}}{4} = 2.0 \times 10^{-10} N$$

2^2

1a) 735N b) 4.45N

2) a 150N b) 24N c) 6N d) 1.5 N

3) $\frac{F_g}{g} = m = 91$ kg $F_g = \frac{Gm_1m_2}{d^2}$ $\frac{F_g d^2}{Gm_1} = m_2$

$\frac{(900)(6.38 \times 10^6)^2}{(6.67 \times 10^{-11})(5.98 \times 10^{24})} = 91$ kg

4) $F_g = \frac{Gm_1m_2}{d^2}$

$\frac{114 \times (8.7 \times 10^5)^2}{(6.67 \times 10^{-11})(70)} = 1.85 \times 10^{22}$ kg 5) $0.61 \frac{N}{kg}$

6) Skip 7) a) 3200N, b) 7200N c) 80000N d) 8.0×10^5 N

8) 534 $\frac{N}{kg}$ 8b) 534N