The gravitational field

Gravity caused by the earth

$$F_g = m.g \qquad F_g = G.\frac{m_1.m_2}{r^2}$$

$$F_g = 100kg.9{,}81\frac{N}{kg} = 981N$$

equal

$$F_g = 6{,}67.10^{-11}.\frac{5{,}98.10^{24}.100}{(6378.10^3)^2} = 981N$$

The gravitational field

$$F_g = m.g \qquad F_g = G.\frac{m_1.m_2}{r^2}$$

$$g = G.\frac{m_1}{r^2}$$

$$F_{net} = m.a$$

$$\frac{N}{kg} = \frac{kg.\frac{m}{s^2}}{kg} = \frac{m}{s^2}$$

The gravitational field

Example: Calculate the gravitional field on Mars. Mars has a density of 3933,5kg/m³ and an average radius of 3386 km.

$$g = G.\frac{m_1}{r^2} \qquad \rho = \frac{m}{V} \qquad m = \rho.V \qquad m = \rho.\frac{4}{3}\pi.r^3$$

$$g = G.\frac{\rho\frac{4}{3}\pi.r^3}{r^2} \qquad g = G.\rho\frac{4}{3}\pi.r$$

$$g = 6{,}67.10^{-11}\frac{Nm^2}{kg^2}.3933{,}5\frac{kg}{m^3}.\frac{4}{3}\pi.3386.10^3 m = 3{,}72\frac{N}{kg}$$

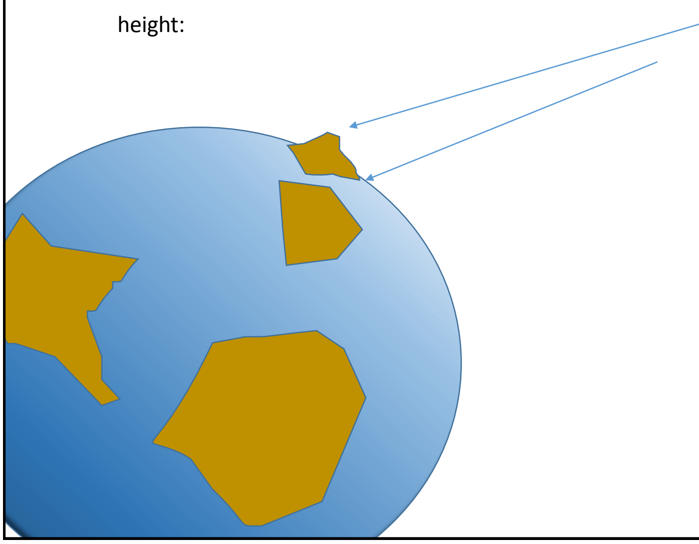
The gravitational field

Factors influencing the gravitational field

height:

Heigth is different at different places or you can be in an airplane. In both cases r is greater:

$$g = G.\frac{m_1}{r^2}$$



The gravitational field

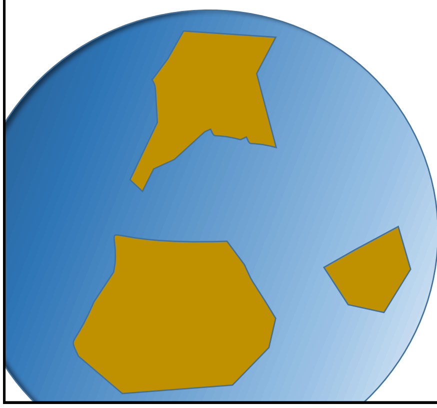
Factors influencing the gravitational field

Density:

$$g = G.\frac{m_1}{r^2}$$

Density differs on different locations on earth: small variations whether you are on dense rock or a lighter medium.

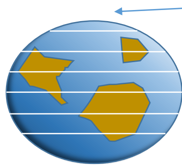
$$g = G.\frac{\rho.V}{r^2}$$



The gravitational field

Factors influencing the gravitational field

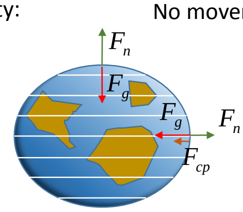
latitude: flattening:



Flattening causes different distances to the centre:

$$g = G.\frac{m_1}{r^2}$$

Angular velocity:



No movement at north pole: $\vec{F}_{net} = 0 = \vec{F}_n + \vec{F}_g$ $F_n = F_g = m.g_{northpole}$

$$\vec{F}_g + \vec{F}_n = m.\vec{a}$$

$$F_n = F_g - m.r_A.\omega^2$$

$$= m.g_{northpole} - m.r_A.\omega^2$$

$$m.g_{equator} = m.g_{northpole} - m.r_A.\omega^2$$

$$g_{equator} = g_{northpole} - r_A.\omega^2$$