Answer on Question #44296, Physics, Other

Question:

find the acceleration due to gravity at depth of 400 km from the earth's surface. (g=9.8 m/s sq R=6400 km)

Answer:

The acceleration due to gravity of Earth on surface equals:

$$g_0 = -\frac{GM}{R^2}$$

where M is mass of the Earth, R is radius of the Earth.

Mass of Earth equals:

$$M = \frac{4}{3}\pi R^3 \rho$$

where ρ is density of the Earth.

Therefore:

$$g_0 = -\frac{GM}{R^2} = -\frac{G\frac{4}{3}\pi R^3 \rho}{R^2} = -\frac{4}{3}G\pi R\rho$$

An approximate depth dependence of density in the Earth can be obtained by assuming that the mass is spherically symmetric. In such a body, the gravitational acceleration is towards the center. The gravity at a radius r depends only on the mass inside the sphere of radius r; all the contributions from outside cancel out.

$$g = -\frac{4}{3}G\pi(R-d)\rho$$

where d is depth.

$$g = -\frac{4}{3}G\pi R\rho\frac{(R-d)}{R} = g_0\frac{(R-d)}{R} \cong 9.2\frac{m}{s^2}$$

Answer: $9.2\frac{m}{s^2}$