Answer on Question 49758, Physics, Mechanics | Kinematics | Dynamics

Question:

A $100kg$ scientist finds that the acceleration of gravity at the north and south pole is measured to be $9.832\frac{m}{s^2}$ and only $9.780\frac{m}{s^2}$ at the equator. If the mass of the Earth is $5.98\cdot 10^{24}kg$, determine the radius of the Earth at the equator and at the poles.

Solution:

By the definition of the acceleretation of gravity we have:

$$g = G\frac{M_E}{R^2},$$

where g is the acceleration of gravity, $G = 6.67\cdot 10^{-11}\frac{Nm^2}{kg^2}$ is the gravitational constant, $M_E = 5.98\cdot 10^{24}kg$ is the mass of the Earth and R is the radius of the Earth.

From this formula we can find the radius of the Earth at the equator and at the poles:

$$R_{eq} = \sqrt{G\frac{M_E}{g_{eq}}} = \sqrt{\frac{6.67\cdot 10^{-11}\frac{Nm^2}{kg^2}\cdot 5.98\cdot 10^{24}kg}{9.780\frac{m}{s^2}}} = 6.386223\cdot 10^6 m.$$

$$R_{pole} = \sqrt{G\frac{M_E}{g_{pole}}} = \sqrt{\frac{6.67\cdot 10^{-11}\frac{Nm^2}{kg^2}\cdot 5.98\cdot 10^{24}kg}{9.832\frac{m}{s^2}}} = 6.369312\cdot 10^6 m.$$

Answer:

a) $R_{eq} = 6.386223\cdot 10^6 m.$

b) $R_{pole} = 6.369312\cdot 10^6 m.$