Answer on Question 49843, Physics, Mechanics | Kinematics | Dynamics

Question:

What would be the length of the day if the Earth rotated so fast that object at equator had no weight? Take the radius of the earth as 6400 km.

Solution:

Let's write the forces that acting on the object at the equator:

$$N - mg = -\frac{mv^2}{R_E}.$$

An object will have no weight when the gravitational force of Earth will be compensated by the centripetal force. Thus, $N = 0$ and we obtain:

$$mg = \frac{mv^2}{R_E}.$$

From this formula we can obtain the speed of the object:

$$v = \sqrt{gR_E} = \sqrt{9.8\frac{m}{s^2} \cdot 6.4 \cdot 10^6 m} = 7.92 \cdot 10^3 \frac{m}{s}.$$

So, the time will be:

$$t = \frac{s}{v} = \frac{2\pi R_E}{v} = \frac{2 \cdot 3.14 \cdot 6.4 \cdot 10^6 m}{7.92 \cdot 10^3 \frac{m}{s}} = 5075s = 1.41 hours.$$

Answer:

The length of the day will be 1.41 hours.