Answer on Question 78088, Physics, Astronomy, Astrophysics

Question:

A body has a weight 90 kg on the surface of the Earth, the mass of the Moon is $1/9$ that of Earth's mass and its radius is $1/2$ that of the Earth's radius. On the Moon the weight of the body is?

Solution:

As we know, the acceleration due to gravity on the surface of the Earth is given by the formula:

$$g_E = \frac{GM_E}{R_E^2},$$

here, G is the universal gravitational constant, M_E is the mass of the Earth, R_E is the radius of the Earth.

Then, from the definition of the weight, we can find the weight of the body on the Earth:

$$W_E = m\frac{GM_E}{R_E^2} = mg_E, (1)$$

here, m is the mass of the body.

Also, we know from the condition of the question that $M_M = \frac{1}{9}M_E,\ R_M = \frac{1}{2}R_E$.

Then, the acceleration due to gravity on the surface of the Moon will be:

$$g_M = \frac{G\frac{1}{9}M}{\left(\frac{1}{2}R\right)^2} = \frac{4}{9}\frac{GM}{R^2} = \frac{4}{9}g_E.$$

Then, the weight of the body on the Moon:

$$W_M = m\frac{4}{9}g_E\ (2).$$

Let's divide equation (2) by equation (1), we get:

$$\frac{W_M}{W_E} = \frac{m\frac{4}{9}g_E}{mg_E} = \frac{4}{9}.$$

Then, we can find the weight of the body on the Moon:

$$W_M = \frac{4}{9} \cdot W_E = \frac{4}{9} \cdot 90\ kg = 40\ kg.$$

Answer:

$W_M = 40\ kg.$