Answer on Question 55221, Physics, Mechanics | Kinematics | Dynamics

Question:

A man weighs $750N$ on the surface of the Earth. What would be his weight when standing on the Moon? The masses of the Earth and the Moon are respectively $5.98 \cdot 10^{24}kg$ and $7.36 \cdot 10^{22}kg$. Their radii are $6.37 \cdot 10^{3}km$ and $1.74 \cdot 10^{3}km$ respectively.

Solution:

Let's write the acceleration due to gravity on the surface of the Earth:

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

where, G is the gravitational constant, M_E is the mass of the Earth and R_E is the radius of the Earth.

Similarly we can write the acceleration due to gravity on the surface of the Moon:

$$g_M = \frac{GM_M}{R_M^2},$$

where, G is the gravitational constant, M_M is the mass of the Moon and R_M is the radius of the Moon.

Let's take the ratio between g_E and g_M:

$$\frac{g_E}{g_M} = \frac{M_E R_M^2}{R_E^2 M_M}.$$

From this expression we can find g_M:

$$g_M = g_E \frac{R_E^2 M_M}{M_E R_M^2} = 9.8 \frac{m}{s^2} \cdot \frac{(6.37 \cdot 10^6 m)^2 \cdot 7.36 \cdot 10^{22} kg}{5.98 \cdot 10^{24} kg \cdot (1.74 \cdot 10^6 m)^2} = 1.62 \frac{m}{s^2}.$$

By the definition of the weight we have:

$$W_E = mg_E,$$

where, W_E is the weight of the man on the surface of the Earth, m is the mass of the man, and g_E is the acceleration due to gravity on the surface of the Earth.

Then, from this formula we can find the mass of the man:

$$m = \frac{W_E}{g_E} = \frac{750N}{9.8\frac{m}{s^2}} = 76.5kg.$$

Finally, from the similar formula we can find the weight of the man on the surface of the Moon:

$$W_M = mg_M = 76.5kg \cdot 1.62\frac{m}{s^2} = 124N.$$

Answer:

$W_M = 124N.$