Answer on Question #40853, Physics, Mechanics

A man weighs 750 N 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, 5.98×10²⁴ kg and 7.36×10²² kg. Their radii are respectively 6.37×10³ km and 1.74×10³ km.

Solution

Weight is the force gravity exerts on an object due to its mass. Newton's Law of Universal Gravitation says that everything that has mass attracts every other thing that has mass, pulling with a force (a) directly proportional to the product of the two objects' masses and (b) inversely proportional to the square of the distance separating their centers.

Written as a formula, Newton's gravitation law looks like this:

$$F = G \frac{Mm}{R^2}$$

where

F is the gravitational force between two objects (weight of a man in our case),

G is the Gravitational Constant,

M is the planet's mass (kg),

m is a man mass (kg), and

R is the distance (m) between the centers of the two masses (the planet's radius).

In our case

$$\frac{F_1}{F_2} = \frac{M_1 R_2^2}{M_2 R_1^2}$$

Thus, the weight on the moon is

$$F_2 = F_1 \frac{M_2 R_1^2}{M_1 R_2^2} = 750 \cdot \frac{7.36 \cdot 10^{22} \cdot 6.37^2 \cdot 10^6}{5.98 \cdot 10^{24} \cdot 1.74^2 \cdot 10^6} = 123.7 \text{ N}$$

Answer. 123.7 N.

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