

Video Notes for Mass Versus Weight

Central Questions:

- What exactly is mass and weight?
- How are they different?
- And how are they related?

Definition of Mass:

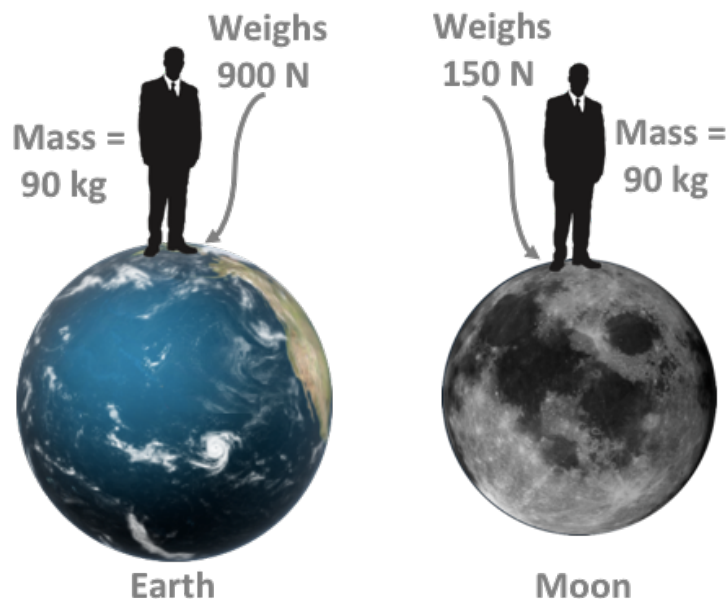
- The amount of stuff (more precisely, matter) that is present in an object.
- Unit: kilogram (kg)

Definition of Weight:

- The force of gravity that acts on an object.
- Unit: Newton (N)

Mass, Weight, and Location:

- Mass does not depend on location.
- Weight depends on location; it varies with the gravitational environment that the object is in.
- A 90-kg person weighs approximately 900 N on Earth; but on the moon, the same 90-kg person weighs approximately 150 N.



The Mass-Weight Relationship

$$\text{Weight} = F_{\text{grav}} = m \cdot g$$

m = mass of object (kg)
 g = gravitational field constant (N/kg)
On Earth, it's value is 9.8 N/kg.
On the moon, g is ~ 1.7 N/kg.
On Mars, g is ~ 3.8 N/kg.

Because g varies with location, the weight of an object varies with location. But the mass of the object is everywhere the same.

Calculating Weight

Calculate the weight of a 90-kg person on Earth ($g = 9.8$ N/kg):

$$\text{Weight} = m \cdot g = (90 \text{ kg}) \cdot (9.8 \text{ N/kg}) = 882 \text{ N} \quad (= \sim 900 \text{ N})$$

Calculate the weight of a 90-kg person on the moon ($g = 1.7$ N/kg):

$$\text{Weight} = m \cdot g = (90 \text{ kg}) \cdot (1.7 \text{ N/kg}) = 153 \text{ N} \quad (= \sim 150 \text{ N})$$

Calculating Mass

What mass does an object need to weigh 900 N on Mars, where g is 3.8 N/kg?

Rearrange the equation to the form of $m = \text{Weight}/g$

$$\text{Substitute and solve: } m = (900 \text{ N}) / (3.8 \text{ N/kg}) = 236.84 \dots \text{ kg} \quad (= \sim 240 \text{ kg})$$