Mass and Weight

by

Nada Saab

P3.6C Explain how your weight on Earth could be different from your weight on another planet.

P2.1F Distinguish between rotation and revolution and describe and contrast the two speeds of an object like the Earth.

The Concept of Mass (m)

Mass is a measure of the amount of “stuff” contained in an object.

It is some “intrinsic property” of an object.

If the amount of “stuff” in an object does not change, the mass does not change.

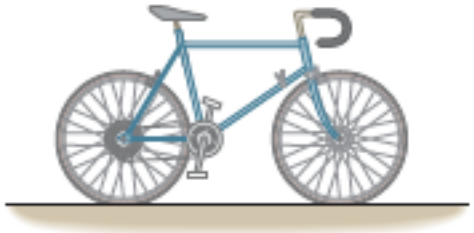
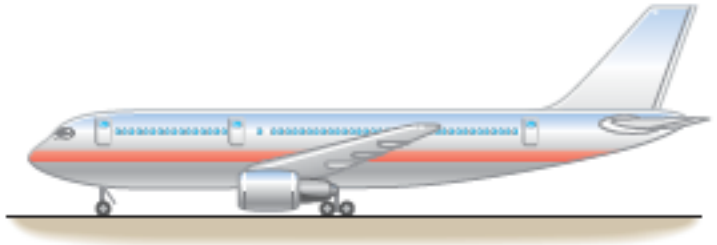
mass # weight

Newton's First Law of Motion

Inertia is the natural tendency of an object to remain at rest or in motion at a constant speed along a straight line.

The *mass* of an object is a quantitative measure of inertia.

SI unit of mass is kilogram (Kg). The symbol of mass is m.

The Mass (m) of Various Objects		
 Penny (0.003 kg)	 Bicycle (15 kg)	 Jetliner (1.2×10^5 kg)
m = 0.003 kg	m = 15 kg	m = 120000 kg

The mass of the penny is 0.003 kg (m = 0.003 kg)

The mass of the bicycle is 15 kg (m = 15 kg)

The mass of the jetliner is 120000 kg (m = 120000 kg)

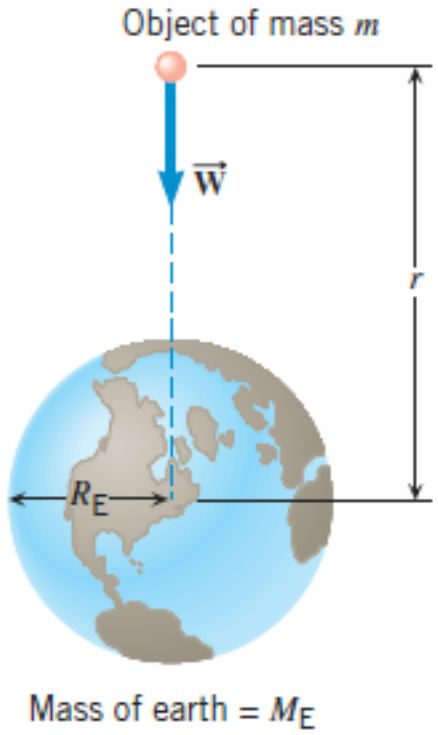
Definition of Weight (W)

The *weight* of an object on or above the earth is the gravitational force that the earth exerts on the object. The weight always acts downward, toward the center of the earth.

On or above another astronomical body, the weight is the gravitational force exerted on the object by that body.

SI Unit of Weight: newton (N)

The picture below shows how the weight (W) of an object of mass (m) is a force directed toward the center of the earth.



Relation Between Mass and Weight

How to calculate the weight of an object if we know the mass of that object?

There is a formula to do the calculation. It is related to Newton's Second Law of Motion.

The formula is shown in the table below.

Weight (W)

Weight = (Mass) x (Gravitational Field Strength)

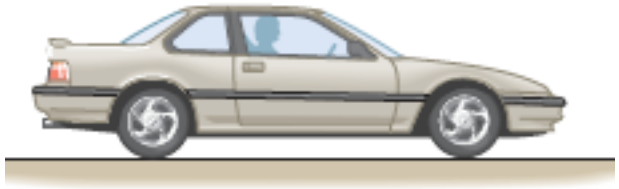
$$W = m \times g$$

W: Weight is measured in Newton (N)

m: Mass is measured in kilogram (Kg)

g: gravitational field strength. It is different on each planet.

At the surface of the Earth, g = 9.8 N/kg.



Car
(2000 kg)

At the surface of the earth, the car has a mass of 2000 kg.

The weight of the car can be calculated as shown below, using the formula of weight.

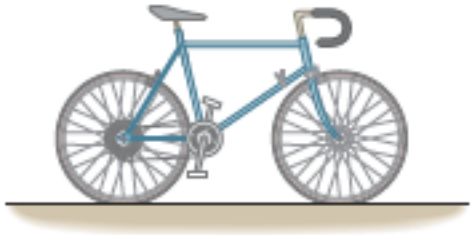
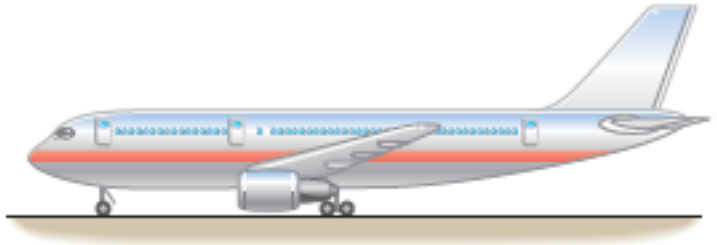
Weight (W)
$W = m \times g = 2000 \times 9.8 = 19600$ Newton

So, the car has a weight of 19600 N.

Newton's First Law of Motion- Practice Problems

Answer questions 1 and 2.

1. Calculate the weight of each of the objects shown below (Penny, Bicycle, Jetliner). The mass of each object is given in Kg.

 Penny (0.003 kg)	 Bicycle (15 kg)	 Jetliner (1.2×10^5 kg)

2. The table shows how the weight of a 57 kg person changes at the surface of different planets.

Planet	g - gravitational field strength at surface (N/kg).	Mass (m) on planet's surface in kg	Weight (w), of this mass in Newton
Jupiter	26	57	1482
Earth	9.8	57	558.6
Venus	8.1	57	462
Mercury	3.3	57	188
Moon	1.63	57	92.91

Use the information in the table and explain why the weight of a 57 kg person on Earth is different from his/her weight on other planets. For that answer the following questions:

a) Does the mass change on the different planets? Why?

b) Does the weight change on the different planets? Why?

c) When the value of g increases, does the weight increase or decrease?

Write a conclusion in your own words.