



The Difference Between Mass and Weight

Calculating the Weight (force) and Mass of an Object

Materials/Equipment/Supplies/Software

Pen/Pencil

Gram Scale (3Beam or
electronic)

Calculator

3-5 lb Spring scale
1 kg mass

Notebook

GEARS 3" Hex Wheel and
Assorted Components

Mass is Different From Weight

Mass is the amount of matter in an object. The standard kilogram is an equivalent amount of matter equal to 1000 cubic centimeters of water.

Weight is the force of gravity acting to pull an object towards the center of the earth.

Newtons and Pounds are Units of Force

Hold a 1 kg mass in your hand.

A mass of 1 Kilogram exerts a force (weight) in your hand of 9.8 Newtons.
(1kg mass exerts a force of approximately 2.2 lbs on your hand.)

This is how you calculate the equivalent force of 1 lb in Newtons

$9.8 \text{ Newtons} / 2.2\text{lbs} = 4.45 \text{ Newtons per lb of force (lbf)}$

Therefore $1\text{lbf} = 4.45 \text{ Newtons}$

Try This

Hold a GEARS 3" hex wheel in your hand. The GEARS 3" hex wheel has a mass of approximately 63 grams. *Check this on your scale. Don't be concerned if the value you measure is 1-2 grams different.*

The "weight" you feel on your hand is a force caused by the mutual attraction between the mass of the earth and the 3" hex wheel. This force is the product of the mass of the wheel (*approx. 63 grams or 0.063 kg*) x acceleration of gravity (*9.8 meters/sec²*).

Follow the procedure below and determine the mass and weight (force) of the wheel in Newtons.

Mass the wheel on a gram scale. Record your answer.

A 1 kg mass exerts 9.8 Newtons of force perpendicular (normal) to the earth's surface.
The Wheel has a mass of .063kg.

Force is a product of mass x acceleration caused by gravity.

Wheel mass x 9.8 Newtons = Perpendicular force exerted by the wheel.

$0.063\text{kg} \times 9.8 \text{ Newtons} = 0.617 \text{ Newtons}$

This GEARS component exerts a force on your hand of approximately 0.62 N

Note: The weight of the wheel only acts in the direction we call down. More accurately it acts toward the center of the earth.

Can You Do This?

Find any combination of GEARS components who's combined mass will exert a downward force of:

1 Newton	12Newtons	2 Newtons
3 Newtons	7 Newtons	6 Newtons
9.8 Newtons	11 Newtons	8.75 Newtons

Search through the GEARS-IDS kit of parts and use a gram scale to mass the items you pick.

Use the weight formula: $W = mg$

W = Weight (Force in Newtons)

M = mass in kilograms

G = acceleration of gravity (9.8 meters/sec²)