

What is gravity? What is gravity?

What is the gravitational force of the Earth? The more massive an object is, the more gravitational force it has? This article will give you the answer.

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1. What is gravity?

Gravity is the force that attracts two objects towards each other, the force that makes planets revolve around the sun, the force that makes an apple fall to the ground.

Gravity is the force acting at a distance across the space between objects.

The more massive an object is, the stronger its gravitational force is.

2. Law of universal gravitation

Law: The gravitational force between any two points is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.

Recipe

Picture 1 of What is gravity? What is gravity?

m_1, m_2 : mass of two point objects.

r : distance between them.

Gravitational constant $G = 6.67 \cdot 10^{-11} \text{ Nm}^2 / \text{kg}^2$.

Conditions for applying the law

1. The distance between two objects is very large compared to their size, then the two objects are considered two point objects.
2. The objects are homogeneous and spherical in shape. Then r is the distance between the two centers and the gravitational force lies on the line joining the centers.

Gravity on Earth

Gravity is essential to us. We couldn't live on Earth without it. The sun's gravity keeps the Earth orbiting it, keeping us at a comfortable distance to enjoy the sun's light and warmth. It maintains the atmosphere and air we need to breathe. Gravity is what holds our world together.

However, gravity is not the same everywhere on Earth. Gravity is slightly stronger in places with more mass underground than in places with less mass. NASA uses two spacecraft to measure these variations in Earth's gravity. The spacecraft are part of the Gravity Recovery and Climate Experiment (GRACE) mission.

Note that weight and gravity are two completely different concepts.

Formula for calculating gravity

Picture 2 of What is gravity? What is gravity?

In there:

m is the mass of the object (kg)

M and R are the mass and radius of the Earth

h is the height of the object above the ground (m)

We also have $P = mg$ so the free fall acceleration:

Picture 3 of What is gravity? What is gravity?

If the object is close to the ground (h

Picture 4 of What is gravity? What is gravity?

Examples of gravitational force

Lesson 1:

Two ships with a mass of 50,000 tons are 1 km apart. Calculate the gravitational force between them.

Instruct:

Conversion: 50000 tons = $5 \cdot 10^7$ kg, 1 km = 1000 m

The magnitude of the gravitational force between them is:

$$F_{hd} = G \frac{M_1 M_2}{r^2} = 6,67 \cdot 10^{-11} \cdot \frac{(5 \cdot 10^7)^2}{1000^2} = 0,167 \text{ (N)}$$

Lesson 2:

The mass of the Moon is 81 times smaller than the mass of the Earth, the distance between the center of the Earth and the center of the Moon is 60 times the radius of the Earth. The gravitational force of the Earth and the Moon acting on the same object are equal at which point on the line connecting their centers?

Prize:

Let the mass of the Moon be M ? the mass of the Earth is $81 M$

The radius of the Earth is R , then the distance between the center of the Earth and the center of the Moon is $60 R$.

Let h be the distance from the point to the center of the Earth ? the distance from that point to the center of the Moon is $60R - h$ ($R, h > 0$)

According to the problem: The gravitational force of the Earth acting on that object is balanced by the gravitational force from the Moon acting on the object:

$$F_{hd_1} = F_{hd_2}$$

$$\Rightarrow \frac{G \cdot 81M \cdot m}{h^2} = \frac{GMm}{(60R - h)^2}$$

$$\Rightarrow h = 54R$$

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