

What are Newton's Laws of Motion?

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Image 1. A sketch of the English physicist and mathematician Isaac Newton. Legend holds that Newton was inspired to write his "Philosophiæ Naturalis Principia Mathematica," which features his laws of gravitation and motion, in part by the sight of a falling apple in an orchard. Image: Mary Evans/Science Source

Newton's Laws of Motion help us to understand how objects behave when they are standing still, when they are moving and when forces act upon them. There are three laws of motion. Here is a description of Sir Isaac Newton's Laws of Motion and a summary of what they mean.

Newton's First Law Of Motion

Newton's First Law of Motion states that an object in motion tends to stay in motion unless an external force acts upon it. Similarly, if the object is at rest, it will remain at rest unless an unbalanced force acts upon it. Newton's First Law of Motion is also known as the Law of Inertia.

Basically, what Newton's First Law is saying is that objects behave predictably. If a ball is sitting on your table, it isn't going to start rolling or fall off the table unless a force acts upon it to cause it to do so. Moving objects don't change their direction unless a force causes them to move from their path.

As you know, if you slide a block across a table, it eventually stops rather than continuing on forever. This is because the frictional force opposes the continued movement. If you threw a ball out in space, there is much less resistance, so the ball would continue onward for a much greater distance.

Newton's Second Law Of Motion

Newton's Second Law of Motion states that when a force acts on an object, it will cause the object to accelerate. The larger the mass of the object, the greater the force will need to be to cause it to accelerate. This law may be written as force = mass x acceleration or:

$$F = m * a$$

Another way to state the Second Law is to say it takes more force to move a heavy object than it does to move a light object. Simple, right? The law also explains deceleration or slowing down. You can think of deceleration as acceleration with a negative sign on it. For example, a ball rolling down a hill moves faster or accelerates as gravity acts on it in the same direction as the motion (acceleration is positive). If a ball is rolled up a hill, the force of gravity acts on it in the opposite direction of the motion (acceleration is negative, or the ball decelerates).

Newton's Third Law Of Motion

Newton's Third Law of Motion states that for every action, there is an equal and opposite reaction.

What this means is that pushing on an object causes that object to push back against you, the exact same amount, but in the opposite direction. For example, when you are standing on the ground, you are pushing down on the Earth with the same magnitude of force that it is pushing back up at you.

History Of Newton's Laws Of Motion

Sir Isaac Newton introduced the three Laws of Motion in 1687 in his book entitled "Philosophiae Naturalis Principia Mathematica" (or simply "The Principia"). The same book also discussed the theory of gravity. This one volume described the main rules still used in classical mechanics today.

Quiz

- 1 Which statement would be MOST important to include in a summary of the article?
- (A) The three Laws of Motion explain why a ball that rolls up a hill will begin to slow down as it goes higher up the hill.
 - (B) The three Laws of Motion were created in 1687 and are found in the same physics volume where gravity is described.
 - (C) The three Laws of Motion include the Law of Inertia, which explains that objects in motion will remain in motion unless acted upon.
 - (D) The three Laws of Motion show how objects react when they are not moving, when they are moving, and when forces act on them.

- 2 Is there more than one central idea of the article? How do you know?
- (A) Yes; the article demonstrates the importance of three Laws of Motion and the other laws that are found in "The Principia."
 - (B) Yes; the article illustrates Sir Isaac Newton's process for arriving at the three Laws of Motion and the other laws that are found in "The Principia."
 - (C) No; the article is about explaining what the three Laws of Motion are and the rest of the details revolve around that one central idea.
 - (D) No; the article is about Sir Isaac Newton's process for arriving at the three Laws of Motion and the rest of the details revolve around that one central idea.

- 3 Read the paragraph from the section "History Of Newton's Laws Of Motion."

Sir Isaac Newton introduced the three Laws of Motion in 1687 in his book entitled "Philosophiæ Naturalis Principia Mathematica" (or simply "The Principia"). The same book also discussed the theory of gravity. This one volume described the main rules still used in classical mechanics today.

Which option is the BEST definition of the word "classical" as used in the paragraph?

- (A) modern and dynamic
- (B) traditional and long-established
- (C) restrained and plain
- (D) harmonious and symmetrical

- 4 Read the paragraph from the section "Newton's First Law Of Motion."

As you know, if you slide a block across a table, it eventually stops rather than continuing on forever. This is because the frictional force opposes the continued movement. If you threw a ball out in space, there is much less resistance, so the ball would continue onward for a much greater distance.

Which word from the paragraph helps you understand that forces sometimes work against an object in motion?

- (A) forever
- (B) resistance
- (C) onward
- (D) distance