Force & Motion

Section 2: Acceleration



Velocity and acceleration are important concepts in physics that describe how objects move and how that motion changes over time. While speed tells how fast an object is moving, **velocity** describes both the speed and the direction of the motion. Because direction matters, two objects traveling at the same speed can have different velocities if they are moving in different directions. For example, a car traveling 60 kilometers per hour north has a different velocity than a car traveling 60 kilometers per hour south.

Understanding velocity is especially important when tracking moving objects such as airplanes, ocean currents, or severe storms. Meteorologists must know both the speed and direction of a hurricane in order to predict where it may travel, and which areas could be affected. Without direction, scientists would not be able to accurately forecast the storm's path.

Another important concept related to motion is acceleration. **Acceleration** is the rate at which velocity changes over time. An object accelerates whenever its speed changes, its direction changes, or both. This means acceleration can occur even if an object is moving at a constant speed but turning in a different direction. For example, a car driving around a curve is accelerating because its direction is changing. To calculate acceleration, scientists divide the change in velocity by the amount of time over which the change occurs.

Acceleration (a) = change in velocity / time

$$a = \frac{v_f - v_i}{t}$$

A soccer player is running at 7 m/s. She then trips and comes to stop. This took 3 seconds. What is the acceleration?

Acceleration can be positive or negative depending on how an object's motion changes. **Positive acceleration** occurs when an object speeds up. For example, an airplane experiences positive acceleration as it gains speed down the runway before takeoff. **Negative acceleration**, also called deceleration, occurs when an object slows down. A bicyclist squeezing the brakes to stop at a traffic light is an example of negative acceleration.

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Section 2: Acceleration Cont.

Rapid acceleration can place large forces on objects and people. Riders on a roller coaster may feel pushed back into their seats when the coaster speeds up quickly or pulled forward when it suddenly slows down. By studying velocity and acceleration, scientists and engineers can better understand motion and design safer vehicles, roads, and transportation systems.

Review:

1. Define velocity.
2. When does acceleration occur?
3. Compare positive acceleration to negative acceleration.

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