

Continue























Velocity and acceleration are the two important terms that are related to physics. Velocity refers to the speed of an object in a particular direction whereas acceleration refers to the rate of change of velocity. Velocity and acceleration are both vector quantities as they have magnitude and direction, however, they have several differences. In this article, we will learn about the velocity, acceleration, and the key differences between them. What is Velocity? Velocity is the rate of change of displacement of a body. It is used to determine the speed of an object in a particular direction. Velocity can be positive, negative or may be zero. Mathematically, it can derive as:  $Velocity(v) = \frac{displacement(d)}{time(t)}$  OR  $V = \frac{d}{t}$  Velocity is a vector quantity as it has both magnitude and direction. SI unit of velocity is meter/second Applications of Velocity Velocity provides the concept of an object's motion, including both speed and direction. It provides the calculation of displacement. Velocity is very important in studying the laws of motion and understanding concepts like inertia and momentum. Velocity plays a very crucial role in various engineering disciplines such as aerospace, automotive, and civil engineering, for designing and optimizing motion systems. What is Acceleration? Acceleration is the rate of change of velocity of a body. Acceleration can be positive or negative. But it can never be zero. Mathematically, acceleration can be derived as:  $Acceleration = \frac{change\ of\ velocity}{time}$  OR  $a = \frac{\Delta v}{\Delta t}$  Acceleration is a vector quantity as it has both magnitude and direction. SI unit of acceleration is meter/second<sup>2</sup>. Applications of Acceleration Acceleration helps to determine the velocity changes over time. Acceleration is a basic concept in classical mechanics, forming the basis for Newton's laws of motion. Acceleration is important in studying the motion of vehicles, it will help to design safer and more efficient transportation systems. In the fields of robotics and automation, acceleration plays a crucial role. The basic difference between velocity and acceleration is illustrated below- Aspects Velocity Acceleration Definition It is defined as the rate of change of displacement of a body. It is defined as the rate of change of velocity of a body. Formula  $Velocity = \frac{Displacement}{Time}$  ( $\frac{d}{t}$ )  $Acceleration = \frac{Change\ in\ velocity}{Time}$  ( $\frac{v_2 - v_1}{t}$ ) Calculated With  $\frac{Displacement}{velocity}$  Unit of Measurement meter/second (m/s) meter/second<sup>2</sup> (m/s<sup>2</sup>) Value Velocity can be positive, negative or zero. Acceleration can be positive or negative. It can not be zero. Uniform Motion Uniform velocity implies steady speed in a straight line. Uniform acceleration refers to constant change in velocity. Circular Motion The magnitude of velocity remains constant in circular motion. Acceleration changes due to the continuous change in direction. Instantaneous vs. Average Instantaneous velocity means an object's velocity at a certain moment while the average velocity refers to overall displacement over a certain time interval. Instantaneous acceleration means the object's acceleration at a certain time while the average acceleration means overall change in velocity over a specific time span. Example A bike moving at 50 km/h to the north. A bike accelerating from 0 to 120 km/h in 20 seconds. Negative Values Velocity can be negative. Negative velocity represents motion in the opposite direction. Acceleration can also be negative. Negative acceleration represents deceleration or slowing down. Graphical Representation It is determined by the slope of displacement-time graph. It is determined by the slope of velocity - time graph. Area Under the Curve The area under the velocity-time curve signifies displacement. The area under the acceleration-time graph (curve) identifies the change in velocity. Importance It is very crucial to understand the speed and the direction of an object. Acceleration is important to study the change in speed/velocity of an object. Relation Velocity is the integral of acceleration with respect to time. Acceleration is the derivative of change in velocity with respect to time. Human Perception We often relate the velocity with speed. Acceleration is related to the speed ups or slow downs. Similarities between Velocity and Acceleration Apart from the several differences between velocity and acceleration, they have many similarities. These similarities between them are as follows: Both the velocity and acceleration are the vector quantities. They have magnitude as well as direction. Both the velocity and acceleration are related to each other through differentiation. Velocity and acceleration can be positive or negative. Both the concepts are included in kinematics which studies the motion of objects. Also Check Conclusion Both the velocity and acceleration are the fundamental concepts in physics. In summary, the above differences lies in their meanings, formulas, units, measurements and many more points. We also discussed the similarities between velocity and acceleration in this article. difference between velocity and acceleration samioia / Stock / Getty Images Plus You may know that both velocity and acceleration have something to do with how fast an object moves. You're right, but what's the difference between these two terms in physics? Keep reading for more information about velocity, acceleration, and how to tell them apart. Velocity and acceleration both use speed as a starting point in their measurements. Speed, which is the measurement of distance traveled over a period of time, is a scalar quantity. Both velocity and acceleration are vector quantities, meaning that they use both magnitudes and a specified direction. Here are the basic definitions of velocity and acceleration: velocity - the rate of displacement of a moving object over time acceleration - the rate of velocity change over time As you can see, velocity requires speed for its measurement, and acceleration requires velocity for its measurement. In order to properly measure any of these quantities, you'll need to know how both velocity and acceleration work. The difference between an object's starting point and its ending location is its amount of displacement. Two possible values of velocity are an object's average velocity (the average calculation of its velocity over one time period) and its instantaneous velocity (its velocity in one moment in time). You can measure velocity in the following units: m/s - meters per second (used by The International System of Units and Measurements) kph - kilometers per hour (used by countries that use the metric system) mph - miles per hour (used in the United States) If an object's velocity is lower than its speed, you can tell that it did not travel in one direction. You need to measure an object's velocity before you can record any increases in its speed — also known as acceleration. Pressing your foot to the gas pedal makes your car accelerate. But what does that mean in physics? When an object's velocity and acceleration point in the same direction, your speed increases. If its velocity and acceleration point in different directions, your speed decreases, or decelerates. Like velocity, acceleration can be measured by an object's average acceleration (the average amount of acceleration over a period of time) or its instantaneous acceleration (its acceleration rate in one instant). Constant acceleration indicates that an object's acceleration rate was constant in its motion. Acceleration can be constant when the force acting on an object is gravity. Finding an object's average velocity means that you know its displacement, or change in position ( $\Delta s$ ), the change in time during its journey ( $\Delta t$ ), and the direction traveled. The equation for average velocity ( $v$ ) looks like this:  $v = \frac{\Delta s}{\Delta t}$  It gets a bit more complicated when calculating an object's average acceleration ( $a$ ). For that, you'll need to know its change in velocity ( $\Delta v$ ) and the change in time ( $\Delta t$ ). It looks like this:  $a = \frac{\Delta v}{\Delta t}$  Basically, you are figuring out the rate of change in meters per second squared ( $m/s^2$ ). This solution will tell you the proper acceleration for an object over a set period of time. Understanding the relationship between velocity and acceleration can help you predict where an object will go given certain variables. It's just one way for us to learn about how the laws of physics affect nearly everything we do. If you'd like to learn more about the concept of speed, check out an article that discusses the main difference between speed and velocity. In order to continue enjoying our site, we ask that you confirm your identity as a human. Thank you very much for your cooperation. Velocity and acceleration are the two key concepts which are always discussed while studying motion. Velocity can be understood as the speed of a moving body in a particular direction whereas acceleration is any change in the velocity of the object, with respect to time. Motion implies movement; it is the act of moving or more specifically, the change in position of the body, concerning time. Whenever you walk, run or drive you are actually in motion and not only this, flying of birds, swimming of fishes, flowing of water from the river, falling of leaves from trees, rotation and revolution of the earth, is also motion. For a layperson, these two terms are one and the same thing, but in physics, there are subtle differences between velocity and acceleration. Content: Velocity Vs Acceleration Comparison Chart Definition Key Differences Similarities Conclusion Comparison Chart Basis for Comparison Velocity Acceleration Meaning Velocity implies the speed of an object, in the given direction. Acceleration alludes to any change in the velocity of the object with respect to time. What is it? Rate of change of displacement. Rate of change of velocity. Ascertains how fast something is moving and in which direction. How fast the moving object's velocity changes with time. Formula Displacement/Time Velocity/Time Unit of measurement m/s m/s<sup>2</sup> Definition of Velocity In physics, velocity is described as a vector measurement as it has both magnitude and direction, wherein the magnitude represents speed and direction show its direction of motion. Velocity is a physical quantity which describes the rate at which object moves, along with its direction. It implies the rate of change in position of someone or something, with respect to time, i.e. how fast an object displaces itself over time from one point to another. One can change the velocity of the moving body, by making a change in its speed, direction or both. At any point, the velocity of the body is tangent to it's path at that point. Definition of Acceleration A measure of change in velocity, with respect to time, is termed as acceleration. Whenever an object changes its velocity, it is said to be accelerating. It is a vector expression that has both magnitude and direction. An object is said to be accelerated when there is an increase or decrease in its speed or change in the direction of motion or both. It is concerned with how the body's motion is changing with respect to time. The change in object's speed and direction are indicated by the component of acceleration, i.e. direction. When the direction of acceleration is parallel to velocity, then it is believed that object is accelerating or its speed is going up. However, when the direction of acceleration is anti-parallel to velocity, then the object is decelerating, or its speed is slowing down. Moreover, if the component of acceleration is perpendicular to velocity, then it reflects the amount of change in object's direction. There can be two types of acceleration, which are: Centripetal acceleration: When the object travels at a uniform speed in a circular motion, like the revolution of the earth, then this acceleration is called centripetal acceleration because there is a change in the direction of the object. Tangential acceleration: When there is no change in the direction of motion but the speed changes with time, is called tangential acceleration. The difference between velocity and acceleration can be drawn clearly on the following grounds: The velocity of an object refers to the speed in a specific direction. Acceleration implies any change in the velocity of the object with respect to time. Velocity is nothing but the rate of change of displacement. On the other hand, acceleration is the rate of change of velocity with respect to time. Velocity determines the speed of the moving object along with the direction of motion. Conversely, acceleration ascertains the speed of change in velocity of the moving object over a period of time. Velocity is calculated as displacement divided by the time taken in which it takes place. On the contrary, acceleration can be calculated as: change in velocity divided by the time taken while the change took place. The unit of measurement of velocity is meter per second (m/s) whereas the standard unit of acceleration is meter per second squared (m/s<sup>2</sup>). Similarities Both velocity and acceleration are vector quantities, which have both magnitude and direction. Both the expressions can be positive, negative and zero. Conclusion The motion of an object can be explained as distance traveled, which can be uniform or non-uniform, depending on the velocity of the object. The velocity of an object is its displacement per unit of time whereas acceleration is the rate of change of object's velocity over a period of time. Speed is the rate of change of distance (basically how much distance(m) has been covered in a particular time(s)). Velocity is the rate of change of displacement (change of distance in a particular direction with respect to time) , and acceleration is the rate of change of velocity per unit of time. (Amount of increase or decrease in velocity). Also, speed is a scalar quantity but velocity and acceleration are vector quantities. Acceleration and speed are both concepts used to describe the motion of an object, but they have distinct meanings. Speed refers to how fast an object is moving, and it is a scalar quantity that only considers the magnitude of the velocity. On the other hand, acceleration refers to how quickly an object's velocity is changing, and it is a vector quantity that takes into account both the magnitude and direction of the change in velocity. While speed tells us how fast an object is going, acceleration tells us how quickly it is speeding up, slowing down, or changing direction. When it comes to describing the motion of objects, two fundamental concepts often come to mind: acceleration and speed. While both terms are related to the movement of an object, they represent different aspects of motion. In this article, we will explore the attributes of acceleration and speed, highlighting their differences and similarities. Definition and Meaning Acceleration refers to the rate at which an object changes its velocity over time. It is a vector quantity, meaning it has both magnitude and direction. Speed, on the other hand, is a scalar quantity that represents the distance traveled by an object per unit of time, without considering the direction. In simpler terms, acceleration focuses on how quickly an object's velocity changes, while speed focuses on how fast an object is moving regardless of direction. Units of Measurement When it comes to measuring acceleration, the standard unit is meters per second squared (m/s<sup>2</sup>). This unit represents the change in velocity (in meters per second) divided by the time taken (in seconds). On the other hand, speed is typically measured in meters per second (m/s) or other common units such as kilometers per hour (km/h) or miles per hour (mph). The units for speed simply represent the distance traveled divided by the time taken. Relationship between Acceleration and Speed While acceleration and speed are distinct concepts, they are interconnected. Acceleration can affect an object's speed by either increasing or decreasing it. For example, if a car accelerates from rest, its speed will gradually increase over time. On the other hand, if a car decelerates, its speed will decrease. However, it is important to note that acceleration does not solely determine an object's speed. Other factors, such as friction or external forces, can also influence an object's speed. Acceleration in Everyday Life Acceleration plays a crucial role in our daily lives, even if we may not always be aware of it. When we step on the gas pedal of a car, we are causing the vehicle to accelerate, increasing its speed. Similarly, when we press the brake pedal, we are causing the car to decelerate, reducing its speed. Acceleration is also evident in activities such as riding a roller coaster, where the sudden changes in velocity create thrilling experiences. In sports, acceleration is essential for athletes to quickly change their speed or direction, enabling them to perform at their best. Speed in Everyday Life Speed is a concept that we encounter regularly in our daily lives. Whether we are driving a car, riding a bicycle, or simply walking, we are constantly aware of how fast we are moving. Speed is particularly important in transportation, as it determines how quickly we can reach our destinations. In sports, speed is often a crucial factor, whether it's in sprinting, swimming, or cycling. Additionally, speed is a key consideration in various industries, such as logistics and delivery services, where efficiency and timely transportation are essential. Applications of Acceleration Acceleration finds numerous applications in various fields. In physics and engineering, understanding acceleration is crucial for designing vehicles, calculating the forces acting on objects, and predicting the behavior of moving systems. In space exploration, acceleration is vital for launching rockets and maneuvering spacecraft. In medicine, acceleration is studied to analyze the impact of sudden changes in velocity on the human body, such as during car accidents or sports injuries. Furthermore, acceleration is also relevant in fields like robotics, where precise control of movement is necessary. Applications of Speed Speed has a wide range of applications across different domains. In the automotive industry, speed is a critical factor in designing vehicles that can achieve higher velocities while ensuring safety. In sports, speed is a key attribute for athletes aiming to break records or achieve optimal performance. Speed is also important in telecommunications, where data transmission rates are measured in terms of bits per second (bps) or megabits per second (Mbps). Moreover, speed is a significant consideration in the field of computing, as faster processors and internet connections lead to improved efficiency and user experience. Conclusion Acceleration and speed are fundamental concepts in the study of motion. While acceleration focuses on the rate of change of velocity, speed represents the distance traveled per unit of time. Both attributes have their unique applications and play crucial roles in various fields, from physics and engineering to sports and everyday life. Understanding the differences and similarities between acceleration and speed allows us to comprehend the intricacies of motion and appreciate the impact they have on our world. Comparisons may contain inaccurate information about people, places, or facts. Please report any issues. Definitions: Speed or Velocity? Speed is the rate of change of position. It is expressed as distance moved (d) per unit of time (t). Speed is a scalar quantity with dimensions distance/time. Speed is measured in the same physical units of measurement as velocity, but does not contain an element of direction. Speed is thus the magnitude component of velocity. Velocity contains both the magnitude and direction components. Common speeds of moving objects For human beings, an average walking speed is about 3 mph (~5 km/h, 1.39m/s). The speed of long distance jogging for average persons is about 6 mph (~10 km/h, 2.7 m/s). Top athletic sprinters can run at 23.03 mph (~36.85 km/h, 10.24 m/s) within a short distance such as a 200 meters dash. Cycling can average 12 mph (~20 km/h, 5.56 m/s) Car can average 65 mph (~104 km/h, 28.9 m/s ) on highway A 747 Airplane has an average speed 565 m/hr Acceleration Acceleration, (symbol: a) is defined as the rate of change of velocity. It is thus a vector quantity with dimension length/time<sup>2</sup>. To accelerate an object is to change its velocity, which is accomplished by altering either its speed or direction (like in case of uniform circular motion) in relation to time. Acceleration can have positive and negative values. Any time that the sign (+ or -) of the acceleration is the same as the sign of the velocity, the object will speed up. If the signs are opposite, the object will slow down. Acceleration is a vector quantity. When either velocity or direction changes, there is acceleration (or deceleration). To accelerate an object requires the application of a force. Graphing Velocity and Acceleration A car accelerates from rest. The following two graphs are created using a java applet (see below). The graph of velocity (m/sec.) vs. time (sec.) is a straight line for accelerating objects. acceleration = velocity / time What is the slope of this graph? Please enter your answer in the space provided: The graph shows the change in position relative to an initial point. Take, for example, a man walking along a straight road facing the east. Consider if he walks 20m towards the east, then turns back and walks 15m towards the west. While he has travelled 35m in total, he is only 5m from his initial starting point. Hence, his displacement is 5m. With this in mind, here is the formula for velocity: Velocity = displacement / time taken Unit: m/s or ms-1 To better illustrate the difference between speed and velocity, consider the man in the above case again, and assume that his trip took 100s in total. His speed would be 35/100 = 0.35ms-1, while his velocity would be 5/100 = 0.05 ms-1. An important term to remember is uniform velocity. Uniform velocity simply refers to a constant velocity. In other words, the object is travelling away from the initial point at a constant rate in a given direction. In contrast, non-uniform velocity is when velocity changes constantly. This means that the object covers equal displacement in unequal time intervals. This can occur when an object is accelerating, decelerating, or changing direction. Acceleration Velocity and acceleration are intertwined concepts. Acceleration is a measurement that represents the rate of change of the velocity of an object. Negative acceleration is often referred to as deceleration, but for the sake of simplicity, we will stick to the term acceleration to discuss the concept. There are two main types of acceleration: Average acceleration and instantaneous acceleration. Average acceleration is defined by the following equation: Average acceleration = change in velocity / time taken Unit: m/s<sup>2</sup> or ms-2 This refers to the overall rate of change of velocity. If you want to find the acceleration at a specific time point, you can use a velocity-time graph. The simplest method is to draw a tangent to the graph at the time point of interest. This allows you to find the gradient at that point, which represents the rate of change of velocity at that point, i.e. the instantaneous acceleration. Another important term is uniform acceleration. Like uniform velocity, uniform acceleration refers to a constant acceleration. In other words, velocity changes at a constant rate. An example of this is the acceleration of free fall. This refers to the uniform acceleration with which objects fall to the earth due to gravity. The acceleration of free fall near the surface of the earth is approximately 9.81 ms<sup>-2</sup>. Speed, velocity and acceleration are all measurements that deal with how fast an object is moving, but now you know that they are describing very different things. While the main concepts are not too hard to understand, questions can get tricky once other kinematics concepts like projectile motion are introduced. If you find yourself in need of help for kinematics or any other physics concept, Best Physics Tuition has a fun and enriching physics tuition programme for O Level and A Level physics students. Velocity is the rate of displacement of an object. It is measured in m/s. Acceleration is the rate of change of velocity of an object. It is measured in m/s<sup>2</sup>. They are both vector quantities i.e. both magnitude and direction are required to fully specify them. Acceleration versus Velocity comparison chart Acceleration Velocity Nature Vector Vector Calculated with Velocity Displacement Components Velocity, time Distance, time and direction of motion Average Velocity/Time Displacement/Time Unit m/s<sup>2</sup> m/s Equation a=v-t/d Velocity is the change in position (location) of an object per unit time. e.g., a bus traveling at a velocity of 60 miles per hour from North to South. The SI unit of velocity is meters per second (m/s). In general, it is important to indicate the direction of motion when specifying the velocity. In other words, it is a vector quantity, as opposed to a scalar quantity that would specify the speed without mentioning the direction. Acceleration is the change in velocity of an object per unit time. The SI unit of acceleration is meters per second per second i.e., meters per second squared (m/s<sup>2</sup>), e.g., the acceleration of a free-falling object on Earth is 9.8 m/s<sup>2</sup> because of Earth's gravity. Calculating velocity Velocity is the distance an object has moved in a particular direction within a specified time interval. If the object returns to its starting position then the velocity is zero. This video explains how to calculate average velocity over a constant acceleration: Calculating acceleration Instantaneous acceleration is the change in velocity divided by the duration of the interval dt: i.e. The derivative of the velocity vector as a function of time. Average acceleration over a period of time is the change in velocity (Δ) divided by the duration of the period (Δt) Therefore the SI unit of acceleration is meter per second per second, i.e. meter per second squared (m/s<sup>2</sup>). This video explains how to calculate acceleration using the example of a Porsche. Types of Acceleration If an object is moving at constant speed in a circular motion – such as a satellite orbiting the earth – it is said to be accelerating because change in direction of motion means its velocity is changing even if speed may be constant. (See Speed vs Velocity) This is called centripetal (directed towards the center) acceleration. On the other hand, if the direction of motion of the object is not changing but its speed is, this is called tangential acceleration. If the direction of acceleration is in the same direction as that of velocity then the object is said to be speeding up or accelerating. If the acceleration and velocity are in opposite directions then the object is said to be slowing down or decelerating. An example of constant acceleration is the effect of the gravity of earth on an object in free fall. Velocity and Acceleration in a Pendulum An oscillating pendulum with velocity v and acceleration a. When a pendulum swings from side to side, its velocity and acceleration vary — both in magnitude and in direction — at each point during the motion. The magnitude of velocity of a pendulum is highest in the center and lowest at the edges. On the other hand, the magnitude of its acceleration is highest at the edges and lowest at the center. Practical applications An Airbag on a motorcycle. Airbags are deployed as a result of rapid negative acceleration in a vehicle. Applications of velocity in real life are to calculate the time taken for a storm to reach the coastline, the time taken for a satellite to reach moon and so on. Accelerometers are used to measure acceleration of an object. Measurement of acceleration of a vehicle enables to evaluate overall vehicle performance and response. Detection of rapid negative acceleration of a vehicle is used to detect vehicle collision and deploy airbags. The measurement of acceleration is also used to measure seismic activity, inclination and machine vibration. Vibration monitoring is used in industries such as automotive manufacturing, machine tool applications, pharmaceutical production, power generation and power plants, pulp and paper, sugar mills, food and beverage production, water and wastewater, hydropower, petrochemical and steel manufacturing. References Share this comparison via: If you read this far, you should follow us: "Acceleration vs Velocity." Diffeen.com. Diffeen LLC, n.d. Web. 26 May 2025. < > Velocity and acceleration are the two key concepts which are always discussed while studying motion. Velocity can be understood as the speed of a moving body in a particular direction whereas acceleration is any change in the velocity of the object, with respect to time. Motion implies movement; it is the act of moving or more specifically, the change in position of the body, concerning time. Whenever you walk, run or drive you are actually in motion and not only this, flying of birds, swimming of fishes, flowing of water from the river, falling of leaves from trees, rotation and revolution of the earth, is also motion. For a layperson, these two terms are one and the same thing, but in physics, there are subtle differences between velocity and acceleration. Content: Velocity Vs Acceleration Comparison Chart Definition Key Differences Similarities Conclusion Comparison Chart Basis for Comparison Velocity Acceleration Meaning Velocity implies the speed of an object, in the given direction. Acceleration alludes to any change in the velocity of the object with respect to time. What is it? Rate of change of displacement. Rate of change of velocity. Ascertains how fast something is moving and in which direction. How fast the moving object's velocity changes with time. Formula Displacement/Time Velocity/Time Unit of measurement m/s m/s<sup>2</sup> Definition of Velocity In physics, velocity is described as a vector measurement as it has both magnitude and direction, wherein the magnitude represents speed and direction show its direction of motion. Velocity is a physical quantity which describes the rate at which object moves, along with its direction. It implies the rate of change in position of someone or something, with respect to time, i.e. how fast an object displaces itself over time from one point to another. One can change the velocity of the moving body, by making a change in its speed, direction or both. At any point, the velocity of the body is tangent to it's path at that point. Definition of Acceleration A measure of change in velocity, with respect to time, is termed as acceleration. Whenever an object changes its velocity, it is said to be accelerating. It is a vector expression that has both magnitude and direction. An object is said to be accelerated when there is an increase or decrease in its speed or change in the direction of motion or both. It is concerned with how the body's motion is changing with respect to time. The change in object's speed and direction are indicated by the component of acceleration, i.e. direction. When the direction of acceleration is parallel to velocity, then it is believed that object is accelerating or its speed is going up. However, when the direction of acceleration is anti-parallel to velocity, then the object is decelerating, or its speed is slowing down. Moreover, if the component of acceleration is perpendicular to velocity, then it reflects the amount of change in object's direction. There can be two types of acceleration, which are: Centripetal acceleration: When the object travels at a uniform speed in a circular motion, like the revolution of the earth, then this acceleration is called centripetal acceleration because there is a change in the direction of the object. Tangential acceleration: When there is no change in the direction of motion but the speed changes with time, is called tangential acceleration. The difference between velocity and acceleration can be drawn clearly on the following grounds: The velocity of an object refers to the speed in a specific direction. Acceleration implies any change in the velocity of the object with respect to time. Velocity is nothing but the rate of change of displacement. On the other hand, acceleration is the rate of change of velocity with respect to time. Velocity determines the speed of the moving object along with the direction of motion. Conversely, acceleration ascertains the speed of change in velocity of the moving object over a period of time. Velocity is calculated as displacement divided by the time taken in which it takes place. On the contrary, acceleration can be calculated as: change in velocity divided by the time taken while the change took place. The unit of measurement of velocity is meter per second (m/s) whereas the standard unit of acceleration is meter per second squared (m/s<sup>2</sup>). Similarities Both velocity and acceleration are vector quantities, which have both magnitude and direction. Both the expressions can be positive, negative and zero. Conclusion The motion of an object can be explained as distance traveled, which can be uniform or non-uniform, depending on the velocity of the object. The velocity of an object is its displacement per unit of time whereas acceleration is the rate of change of object's velocity over a period of time. Speed is the rate of change of distance (basically how much distance(m) has been covered in a particular time(s)). Velocity is the rate of change of displacement (change of distance in a particular direction with respect to time) , and acceleration is the rate of change of velocity per unit of time. (Amount of increase or decrease in velocity). Also, speed is a scalar quantity but velocity and acceleration are vector quantities. Acceleration and speed are both concepts used to describe the motion of an object, but they have distinct meanings. Speed refers to how fast an object is moving, and it is a scalar quantity that only considers the magnitude of the velocity. On the other hand, acceleration refers to how quickly an object's velocity is changing, and it is a vector quantity that takes into account both the magnitude and direction of the change in velocity. While speed tells us how fast an object is going, acceleration tells us how quickly it is speeding up, slowing down, or changing direction. When it comes to describing the motion of objects, two fundamental concepts often come to mind: acceleration and speed. While both terms are related to the movement of an object, they represent different aspects of motion. In this article, we will explore the attributes of acceleration and speed, highlighting their differences and similarities. Definition and Meaning Acceleration refers to the rate at which an object changes its velocity over time. It is a vector quantity, meaning it has both magnitude and direction. Speed, on the other hand, is a scalar quantity that represents the distance traveled by an object per unit of time, without considering the direction. In simpler terms, acceleration focuses on how quickly an object's velocity changes, while speed focuses on how fast an object is moving regardless of direction. Units of Measurement When it comes to measuring acceleration, the standard unit is meters per second squared (m/s<sup>2</sup>). This unit represents the change in velocity (in meters per second) divided by the time taken (in seconds). On the other hand, speed is typically measured in meters per second (m/s) or other common units such as kilometers per hour (km/h) or miles per hour (mph). The units for speed simply represent the distance traveled divided by the time taken. Relationship between Acceleration and Speed While acceleration and speed are distinct concepts, they are interconnected. Acceleration can affect an object's speed by either increasing or decreasing it. For example, if a car accelerates from rest, its speed will gradually increase over time. On the other hand, if a car decelerates, its speed will decrease. However, it is important to note that acceleration does not solely determine an object's speed. Other factors, such as friction or external forces, can also influence an object's speed. Acceleration in Everyday Life Acceleration plays a crucial role in our daily lives, even if we may not always be aware of it. When we step on the gas pedal of a car, we are causing the vehicle to accelerate, increasing its speed. Similarly, when we press the brake pedal, we are causing the car to decelerate, reducing its speed. Acceleration is also evident in activities such as riding a roller coaster, where the sudden changes in velocity create thrilling experiences. In sports, acceleration is essential for athletes to quickly change their speed or direction, enabling them to perform at their best. Speed in Everyday Life Speed is a concept that we encounter regularly in our daily lives. Whether we are driving a car, riding a bicycle, or simply walking, we are constantly aware of how fast we are moving. Speed is particularly important in transportation, as it determines how quickly we can reach our destinations. In sports, speed is often a crucial factor, whether it's in sprinting, swimming, or cycling. Additionally, speed is a key consideration in various industries, such as logistics and delivery services, where efficiency and timely transportation are essential. Applications of Acceleration Acceleration finds numerous applications in various fields. In physics and engineering, understanding acceleration is crucial for designing vehicles, calculating the forces acting on objects, and predicting the behavior of moving systems. In space exploration, acceleration is vital for launching rockets and maneuvering spacecraft. In medicine, acceleration is studied to analyze the impact of sudden changes in velocity on the human body, such as during car accidents or sports injuries. Furthermore, acceleration is also relevant in fields like robotics, where precise control of movement is necessary. Applications of Speed Speed has a wide range of applications across different domains. In the automotive industry, speed is a critical factor in designing vehicles that can achieve higher velocities while ensuring safety. In sports, speed is a key attribute for athletes aiming to break records or achieve optimal performance. Speed is also important in telecommunications, where data transmission rates are measured in terms of bits per second (bps) or megabits per second (Mbps). Moreover, speed is a significant consideration in the field of computing, as faster processors and internet connections lead to improved efficiency and user experience. Conclusion Acceleration and speed are fundamental concepts in the study of motion. While acceleration focuses on the rate of change of velocity, speed represents the distance traveled per unit of time. Both attributes have their unique applications and play crucial roles in various fields, from physics and engineering to sports and everyday life. Understanding the differences and similarities between acceleration and speed allows us to comprehend the intricacies of motion and appreciate the impact they have on our world. Comparisons may contain inaccurate information about people, places, or facts. Please report any issues. Definitions: Speed or Velocity? Speed is the rate of change of position. It is expressed as distance moved (d) per unit of time (t). Speed is a scalar quantity with dimensions distance/time. Speed is measured in the same physical units of measurement as velocity, but does not contain an element of direction. Speed is thus the magnitude component of velocity. Velocity contains both the magnitude and direction components. Common speeds of moving objects For human beings, an average walking speed is about 3 mph (~5 km/h, 1.39m/s). The speed of long distance jogging for average persons is about 6 mph (~10 km/h, 2.7 m/s). Top athletic sprinters can run at 23.03 mph (~36.85 km/h, 10.24 m/s) within a short distance such as a 200 meters dash. Cycling can average 12 mph (~20 km/h, 5.56 m/s) Car can average 65 mph (~104 km/h, 28.9 m/s ) on highway A 747 Airplane has an average speed 565 m/hr Acceleration Acceleration, (symbol: a) is defined as the rate of change of velocity. It is thus a vector quantity with dimension length/time<sup>2</sup>. To accelerate an object is to change its velocity, which is accomplished by altering either its speed or direction (like in case of uniform circular motion) in relation to time. Acceleration can have positive and negative values. Any time that the sign (+ or -) of the acceleration is the same as the sign of the velocity, the object will speed up. If the signs are opposite, the object will slow down. Acceleration is a vector quantity. When either velocity or direction changes, there is acceleration (or deceleration). To accelerate an object requires the application of a force. Graphing Velocity and Acceleration A car accelerates from rest. The following two graphs are created using a java applet (see below). The graph of velocity (m/sec.) vs. time (sec.) is a straight line for accelerating objects. acceleration = velocity / time What is the slope of this graph? Please enter your answer in the space provided: The graph shows the change in position relative to an initial point. Take, for example, a man walking along a straight road facing the east. Consider if he walks 20m towards the east, then turns back and walks 15m towards the west. While he has travelled 35m in total, he is only 5m from his initial starting point. Hence, his displacement is 5m. With this in mind, here is the formula for velocity: Velocity = displacement / time taken Unit: m/s or ms-1 To better illustrate the difference between speed and velocity, consider the man in the above case again, and assume that his trip took 100s in total. His speed would be 35/100 = 0.35ms-1, while his velocity would be 5/100 = 0.05 ms-1. An important term to remember is uniform velocity. Uniform velocity simply refers to a constant velocity. In other words, the object is travelling away from the initial point at a constant rate in a given direction. In contrast, non-uniform velocity is when velocity changes constantly. This means that the object covers equal displacement in unequal time intervals. This can occur when an object is accelerating, decelerating, or changing direction. Acceleration Velocity and acceleration are intertwined concepts. Acceleration is a measurement that represents the rate of change of the velocity of an object. Negative acceleration is often referred to as deceleration, but for the sake of simplicity, we will stick to the term acceleration to discuss the concept. There are two main types of acceleration: Average acceleration and instantaneous acceleration. Average acceleration is defined by the following equation: Average acceleration = change in velocity / time taken Unit: m/s<sup>2</sup> or ms-2 This refers to the overall rate of change of velocity. If you want to find the acceleration at a specific time point, you can use a velocity-time graph. The simplest method is to draw a tangent to the graph at the time point of interest. This allows you to find the gradient at that point, which represents the rate of change of velocity at that point, i.e. the instantaneous acceleration. Another important term is uniform acceleration. Like uniform velocity, uniform acceleration refers to a constant acceleration. In other words, velocity changes at a constant rate. An example of this is the acceleration of free fall. This refers to the uniform acceleration with which objects fall to the earth due to gravity. The acceleration of free fall near the surface of the earth is approximately 9.81 ms<sup>-2</sup>. Speed, velocity and acceleration are all measurements that deal with how fast an object is moving, but now you know that they are describing very different things. While the main concepts are not too hard to understand, questions can get tricky once other kinematics concepts like projectile motion are introduced. If you find yourself in need of help for kinematics or any other physics concept, Best Physics Tuition has a fun and enriching physics tuition programme for O Level and A Level physics students. Velocity is the rate of displacement of an object. It is measured in m/s. Acceleration is the rate of change of velocity of an object. It is measured in m/s<sup>2</sup>. They are both vector quantities i.e. both magnitude and direction are required to fully specify them. Acceleration versus Velocity comparison chart Acceleration Velocity Nature Vector Vector Calculated with Velocity Displacement Components Velocity, time Distance, time and direction of motion Average Velocity/Time Displacement/Time Unit m/s<sup>2</sup> m/s Equation a=v-t/d Velocity is the change in position (location) of an object per unit time. e.g., a bus traveling at a velocity of 60 miles per hour from North to South. The SI unit of velocity is meters per second (m/s). In general, it is important to indicate the direction of motion when specifying the velocity. In other words, it is a vector quantity, as opposed to a scalar quantity that would specify the speed without mentioning the direction. Acceleration is the change in velocity of an object per unit time. The SI unit of acceleration is meters per second per second i.e., meters per second squared (m/s<sup>2</sup>), e.g., the acceleration of a free-falling object on Earth is 9.8 m/s<sup>2</sup> because of Earth's gravity. Calculating velocity Velocity is the distance an object has moved in a particular direction within a specified time interval. If the object returns to its starting position then the velocity is zero. This video explains how to calculate average velocity over a constant acceleration: Calculating acceleration Instantaneous acceleration is the change in velocity divided by the duration of the interval dt: i.e. The derivative of the velocity vector as a function of time. Average acceleration over a period of time is the change in velocity (Δ) divided by the duration of the period (Δt) Therefore the SI unit of acceleration is meter per second per second, i.e. meter per second squared (m/s<sup>2</sup>). This video explains how to calculate acceleration using the example of a Porsche. Types of Acceleration If an object is moving at constant speed in a circular motion – such as a satellite orbiting the earth – it is said to be accelerating because change in direction of motion means its velocity is changing even if speed may be constant. (See Speed vs Velocity) This is called centripetal (directed towards the center) acceleration. On the other hand, if the direction of motion of the object is not changing but its speed is, this is called tangential acceleration. If the direction of acceleration is in the same direction as that of velocity then the object is said to be speeding up or accelerating. If the acceleration and velocity are in opposite directions then the object is said to be slowing down or decelerating. An example of constant acceleration is the effect of the gravity of earth on an object in free fall. Velocity and Acceleration in a Pendulum An oscillating pendulum with velocity v and acceleration a. When a pendulum swings from side to side, its velocity and acceleration vary — both in magnitude and in direction — at each point during the motion. The magnitude of velocity of a pendulum is highest in the center and lowest at the edges. On the other hand, the magnitude of its acceleration is highest at the edges and lowest at the center. Practical applications An Airbag on a motorcycle. Airbags are deployed as a result of rapid negative acceleration in a vehicle. Applications of velocity in real life are to calculate the time taken for a storm to reach the coastline, the time taken for a satellite to reach moon and so on. Accelerometers are used to measure acceleration of an object. Measurement of acceleration of a vehicle enables to evaluate overall vehicle performance and response. Detection of rapid negative acceleration of a vehicle is used to detect vehicle collision and deploy airbags. The measurement of acceleration is also used to measure seismic activity, inclination and machine vibration. Vibration monitoring is used in industries such as automotive manufacturing, machine tool applications, pharmaceutical production, power generation and power plants, pulp and paper, sugar mills, food and beverage production, water and wastewater, hydropower, petrochemical and steel manufacturing. References Share this comparison via: If you read this far, you should follow us: "Acceleration vs Velocity." Diffeen.com. Diffeen LLC, n.d. Web. 26 May 2025. < > Velocity and acceleration are the two key concepts which are always discussed while studying motion. Velocity can be understood as the speed of a moving body in a particular direction whereas acceleration is any change in the velocity of the object, with respect to time. Motion implies movement; it is the act of moving or more specifically, the change in position of the body, concerning time. Whenever you walk, run or drive you are actually in motion and not only this, flying of birds, swimming of fishes, flowing of water from the river, falling of leaves from trees, rotation and revolution of the earth, is also motion. For a layperson, these two terms are one and the same thing, but in physics, there are subtle differences between velocity and acceleration. Content: Velocity Vs Acceleration Comparison Chart Definition Key Differences Similarities Conclusion Comparison Chart Basis for Comparison Velocity Acceleration Meaning Velocity implies the speed of an object, in the given direction. Acceleration alludes to any change in the velocity of the object with respect to time. What is it? Rate of change of displacement. Rate of change of velocity. Ascertains how fast something is moving and in which direction. How fast the moving object's velocity changes with time. Formula Displacement/Time Velocity/Time Unit of measurement m/s m/s<sup>2</sup> Definition of Velocity In physics, velocity is described as a vector measurement as it has both magnitude and direction, wherein the magnitude represents speed and direction show its direction of motion. Velocity is a physical quantity which describes the rate at which object moves, along with its direction. It implies the rate of change in position of someone or something, with respect to time, i.e. how fast an object displaces itself over time from one point to another. One can change the velocity of the moving body, by making a change in its speed, direction or both. At any point, the velocity of the body is tangent to it's path at that point. Definition of Acceleration A measure of change in velocity, with respect to time, is termed as acceleration. Whenever an object changes its velocity, it is said to be accelerating. It is a vector expression that has both magnitude and direction. An object is said to be accelerated when there is an increase or decrease in its speed or change in the direction of motion or both. It is concerned with how the body's motion is changing with respect to time. The change in object's speed and direction are indicated by the component of acceleration, i.e. direction. When the direction of acceleration is parallel to velocity, then it is believed that object is accelerating or its speed is going up. However, when the direction of acceleration is anti-parallel to velocity, then the object is decelerating, or its speed is slowing down. Moreover, if the component of acceleration is perpendicular to velocity, then it reflects the amount of change in object's direction. There can be two types of acceleration, which are: Centripetal acceleration: When the object travels at a uniform speed in a circular motion, like the revolution of the earth, then this acceleration is called centripetal acceleration because there is a change in the direction of the object. Tangential acceleration: When there is no change in the direction of motion but the speed changes with time, is called tangential acceleration. The difference between velocity and acceleration can be drawn clearly on the following grounds: The velocity of an object refers to the speed in a specific direction. Acceleration implies any change in the velocity of the object with respect to time. Velocity is nothing but the rate of change of displacement. On the other hand, acceleration is the rate of change of velocity with respect to time. Velocity determines the speed of the moving object along with the direction of motion. Conversely, acceleration ascertains the speed of change in velocity of the moving object over a period of time. Velocity is calculated as displacement divided by the time taken in which it takes place. On the contrary, acceleration can be calculated as: change in velocity divided by the time taken while the change took place. The unit of measurement of velocity is meter per second (m/s) whereas the standard unit of acceleration is meter per second squared (m/s<sup>2</sup>). Similarities Both velocity and acceleration are vector quantities, which have both magnitude and direction. Both the expressions can be positive, negative and zero. Conclusion The motion of an object can be explained as distance traveled, which can be uniform or non-uniform, depending on the velocity of the object. The velocity of an object is its displacement per unit of time whereas acceleration is the rate of change of object's velocity over a period of time. Speed is the rate of change of distance (basically how much distance(m) has been covered in a particular time(s)). Velocity is the rate of change of displacement (change of distance in a particular direction with respect to time) , and acceleration is the rate of change of velocity per unit of time. (Amount of increase or decrease in velocity). Also, speed is a scalar quantity but velocity and acceleration are vector quantities. Acceleration and speed are both concepts used to describe the motion of an object, but they have distinct meanings. Speed refers to how fast an object is moving, and it is a scalar quantity that only considers the magnitude of the velocity. On the other hand, acceleration refers to how quickly an object's velocity is changing, and it is a vector quantity that takes into account both the magnitude and direction of the change in velocity. While speed tells us how fast an object is going, acceleration tells us how quickly it is speeding up, slowing down, or changing direction. When it comes to describing the motion of objects, two fundamental concepts often come to mind: acceleration and speed. While both terms are related to the movement of an object, they represent different aspects of motion. In this article, we will explore the attributes of acceleration and speed, highlighting their differences and similarities. Definition and Meaning Acceleration refers to the rate at which an object changes its velocity over time. It is a vector quantity, meaning it has both magnitude and direction. Speed, on the other hand, is a scalar quantity that represents the distance traveled by an object per unit of time, without considering the direction. In simpler terms, acceleration focuses on how quickly an object's velocity changes, while speed focuses on how fast an object is moving regardless of direction. Units of Measurement When it comes to measuring acceleration, the standard unit is meters per second squared (m/s<sup>2</sup>). This unit represents the change in velocity (in meters per second) divided by the time taken (in seconds). On the other hand, speed is typically measured in meters per second (m/s) or other common units such as kilometers per hour (km/h) or miles per hour (mph). The units for speed simply represent the distance traveled divided by the time taken. Relationship between Acceleration and Speed While acceleration and speed are distinct concepts, they are interconnected. Acceleration can affect an object's speed by either increasing or decreasing it. For example, if a car accelerates from rest, its speed will gradually increase over time. On the other hand, if a car decelerates, its speed will decrease. However, it is important to note that acceleration does not solely determine an object's speed. Other factors, such as friction or external forces, can also influence an object's speed. Acceleration in Everyday Life Acceleration plays a crucial role in our daily lives, even if we may not always be aware of it. When we step on the gas pedal of a car, we are causing the vehicle to accelerate, increasing its speed. Similarly, when we press the brake pedal, we are causing the car to decelerate, reducing its speed. Acceleration is also evident in activities such as riding a roller coaster, where the sudden changes in velocity create thrilling experiences. In sports, acceleration is essential for athletes to quickly change their speed or direction, enabling them to perform at their best. Speed in Everyday Life Speed is a concept that we encounter regularly in our daily lives. Whether we are driving a car, riding a bicycle, or simply walking, we are constantly aware of how fast we are moving. Speed is particularly important in transportation, as it determines how quickly we can reach our destinations. In sports, speed is often a crucial factor, whether it's in sprinting, swimming, or cycling. Additionally, speed is a key consideration in various industries, such as logistics and delivery services, where efficiency and timely transportation are essential. Applications of Acceleration Acceleration finds numerous applications in various fields. In physics and engineering, understanding acceleration is crucial for designing vehicles, calculating the forces acting on objects, and predicting the behavior of moving systems. In space exploration, acceleration is vital for launching rockets and maneuvering spacecraft. In medicine, acceleration is studied to analyze the impact of sudden changes in velocity on the human body, such as during car accidents or sports injuries. Furthermore, acceleration is also relevant in fields like robotics, where precise control of movement is necessary. Applications of Speed Speed has a wide range of applications across different domains. In the automotive industry, speed is a critical factor in designing vehicles that can achieve higher velocities while ensuring safety. In sports, speed is a key attribute for athletes aiming to break records or achieve optimal performance. Speed is also important in telecommunications, where data transmission rates are measured in terms of bits per second (bps) or megabits per second (Mbps). Moreover, speed is a significant consideration in the field of computing, as faster processors and internet connections lead to improved efficiency and user experience. Conclusion Acceleration and speed are fundamental concepts in the study of motion. While acceleration focuses on the rate of change of velocity, speed represents the distance traveled per unit of time. Both attributes have their unique applications and play crucial roles in various fields, from physics and engineering to sports and everyday life. Understanding the differences and similarities between acceleration and speed allows us to comprehend the intricacies of motion and appreciate the impact they have on our world. Comparisons may contain inaccurate information about people, places, or facts. Please report any issues. Definitions: Speed or Velocity? Speed is the rate of change of position. It is expressed as distance moved (d) per unit of time (t). Speed is a scalar quantity with dimensions distance/time. Speed is measured in the same physical units of measurement as velocity, but does not contain an element of direction. Speed is thus the magnitude component of velocity. Velocity contains both the magnitude and direction components. Common speeds of moving objects For human beings, an average walking speed is about 3 mph (~5 km/h, 1.39m/s). The speed of long distance jogging for average persons is about 6 mph (~10 km/h, 2.7 m/s). Top athletic sprinters can run at 23.03 mph (~36.85 km/h, 10.24 m/s) within a short distance such as a 200 meters dash. Cycling can average 12 mph (~20 km/h, 5.56 m/s) Car can average 65 mph (~104 km/h, 28.9 m/s ) on highway A 747 Airplane has an average speed 565 m/hr Acceleration Acceleration, (symbol: a) is defined as the rate of change of velocity. It is thus a vector quantity with dimension length/time<sup>2</sup>. To accelerate an object is to change its velocity, which is accomplished by altering either its