

Physics Assignment:

Position, Velocity, and Acceleration

Derivatives are used in Physics applications such as velocity, acceleration, and motion along a line. Velocity may be described as the rate of change of position and acceleration is the rate of change of velocity. The idea of speed is the magnitude of velocity, $|v(t)|$.

Definitions:

- Let $s(t)$ be a function giving the position of an object at time t .
- The velocity of the object at time t is given by $v(t) = s'(t)$.
- The acceleration of the object at time t is given by $a(t) = v'(t) = s''(t)$.
- The speed of the object at time t is given by $|v(t)|$, or magnitude of velocity.

Let us suppose a baseball is launched straight up from the top of a building with an initial velocity of 32 ft per second. The distance in feet that the baseball travels from the ground after t seconds is given by $s(t) = -16t^2 + 32t + 150$, $t \geq 0$.

- a. Show work that finds the velocity function.
- b. At what time does the ball stop rising and begin to fall. Find the average velocity during its fall.
- c. Find the instantaneous velocity of the baseball as it hits the ground. After how many seconds does the baseball hit the ground?
- d. Explain the difference between average velocity and instantaneous velocity.
- e. Show work that finds the acceleration function.
- f. Find the velocity of the baseball at 0.5, 1.5, 2, and 4 seconds after being launched. Explain what is happening at these times. Are these valid? Explain why or why not?
- g. Graph the position, velocity, and acceleration functions. Explain in detail the relationship between the three functions.