Physics Assignment:
Position, Velocity, and Acceleration

Student Learning Outcomes

3.1.5	Describe the velocity as a rate of change
3.1.6	Explain the difference between average velocity and instantaneous velocity
3.3.2	Apply the sum and difference rules to combine derivatives
3.3.6	Combine the differentiation rules to find the derivative of a polynomial or rational function
3.4.2	Calculate the average rate of change and explain how it differs from the instantaneous rate of change
3.4.3	Apply rates of change to displacement, velocity, and acceleration of an object moving along a straight line

Derivatives are used in Physic 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.

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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.

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