Average and Instantaneous Speed

p. 93 - 97 (2.1)

Average Speed is defined by the total distance travelled d divided by the elapsed time period t.
Graphically, the average speed is the slope of the secant line.

Analytically, average speed $= \dfrac{\Delta d}{\Delta t}$

Instantaneous Speed is defined by the speed at a specfic instant in time.
Graphically, the instantaneous speed is the slope of the tangent line.
Analytically, we need ***calculus*** to determine this instantaneous speed.

(calc.)1. A roller coaster has its largest drop modeled by the equation $d(t) = 1.93t^3 - 31.82t^2 + 113.83t + 158.65$ where $d(t)$ is measured in feet and time t is measured in seconds.

(2, 274.47)
(8, 20.97)

a) What is the average speed of the roller coaster from 2 seconds to 8 seconds?

$$\frac{\Delta d}{\Delta t} = \frac{|20.97 \text{ ft} - 274.47 \text{ ft}|}{8 \text{ sec} - 2 \text{ sec}} = \frac{|-253.5 \text{ ft}|}{6 \text{ sec}} = 42.25 \text{ ft/sec}$$

b) What is the average speed of the roller coaster from 4 seconds to 6 seconds? (4, 228.37) (6, 112.99)

$$\frac{\Delta d}{\Delta t} = \frac{|112.99 \text{ ft} - 228.37 \text{ ft}|}{6 \text{ sec} - 4 \text{ sec}} = \frac{|-115.38 \text{ ft}|}{2 \text{ sec}} = 57.69 \text{ ft/sec}$$

c) Estimate the instantaneous speed of the roller coaster at exactly 5 seconds.

$$\text{Instantaneous speed} \approx \frac{\Delta d}{\Delta t} = \frac{|167.561 \text{ ft} - 179.481 \text{ ft}|}{5.1 \text{ sec} - 4.9 \text{ sec}} = 59.6 \text{ ft/sec}$$

(actual value = 59.62 ft/sec)