Lesson 7.1.4

7-37. Happy substituted too early, at $V = 500$, $r \approx 4.924$, the radius is increasing at a rate of 0.066 in/sec therefore the diameter is increasing at a rate of 0.131 in/sec.

7-38. See below:

a. $\frac{dh}{dt} = \frac{-4s+6j}{h}$

b. $\frac{dh}{dt} = -4, -0.638$, and $5.261 \frac{\text{ft}}{\text{sec}}$

c. Yes, since the rates show up in the equation for $\frac{dh}{dt}$. For example, if Jonathon ran faster, the distance between them would increase faster.

7-39. Using a right triangle with hypotenuse 5 and height $(5 - h)$ creates a radius for the surface of $\sqrt{5^2 - (5-h)^2} = \sqrt{10h - h^2}$. Since $A = \pi r^2$, $A = 10\pi h - \pi h^2$. Then $\frac{dA}{dt} = 10\pi \frac{dh}{dt} - 2\pi h \frac{dh}{dt}$.

Substituting $h = 2$, $\frac{dh}{dt} = 1.5$ gives $\frac{dA}{dt} = 9\pi \frac{\text{cm}^2}{\text{sec}}$.

Review & Preview

7-40. Since $A = \pi r^2$, $\frac{dA}{dt} = 2\pi r \frac{dr}{dt}$.

7-41. Since $S = 6x^2$, $\frac{dS}{dt} = 12x \frac{dx}{dt}$.

7-42. Min. occurs at (4, 3), where the second derivative is positive.

7-43. 48.788 mph

7-44. The slope of the tangent must equal the derivative at the point of tangency. Therefore at the point $(x_1, x_1^2 + 2x_1 + 4)$, the slope of the line is $(x_1^2 + 2x_1 + 4) / x_1$ which must equal $y' = 2x_1 + 2$. Solving, we find that $x_1 = \pm 2$. The equations of the tangents are $y = 6x$ and $y = -2x$.

7-45. See below:

a. Find the area under the velocity curve, then divide by total time. ≈ 16.102 miles per hour.

b. Find $\frac{s(6)-s(0)}{6-0} \approx 1.9.9$ miles per hour

c. K: 3.34 hr; V: 1.617 and 4.666 hrs.

7-46. See below:

b. The denominator of $y' = 0$ when $x = 0$ and $y = \frac{1}{2}x^2$. The curve is undefined at $x = 0$, but substituting $y = \frac{1}{2}x^2$ into the original equation gives $x = \sqrt[5]{-48}$.