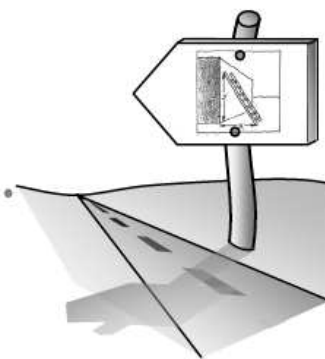


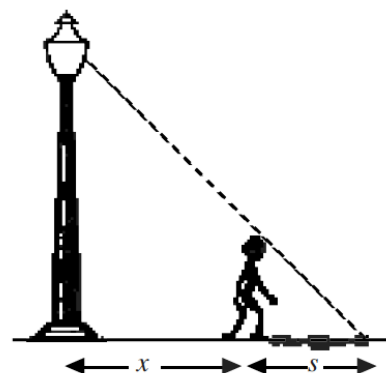
7.1.3 Can I measure my shadow?

Related Rates Applications: Similar Right Triangle



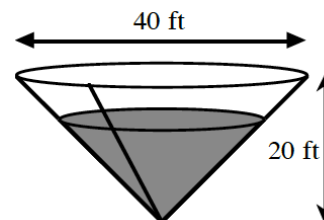
7-25. Eric is walking away from the lamppost.

- If s is the length of his shadow and x is the distance between Eric and the lamppost, then how are $\frac{dx}{dt}$ and $\frac{ds}{dt}$ related?
- Find an equation relating $\frac{dx}{dt}$ and $\frac{ds}{dt}$.
- If Eric (who is 5 feet tall) walks away from the 16-foot tall pole at a rate of $4 \frac{\text{ft}}{\text{sec}}$, at what rate is the length of his shadow increasing when he is 30 feet away from the lamppost.



7-26. THE STORAGE TANK

An empty underground storage water tank has the shape of an inverted cone, 20 feet deep and 40 feet in diameter.



- If the depth of the water in the tank is 15 feet, what is the radius of the water's surface?
- Find a relationship between h (the depth of the water) and r (the radius of the water's surface).
- Find an equation relating the volume of water, V , to the water's depth, h .
- If we start pumping water into the empty tank at the constant rate of 100 gallons per minute, how fast is the depth of the water in the tank changing 10 minutes after we start pumping? (1 gal $\approx 0.13368 \text{ ft}^3$)

7-27. With your team, determine steps for solving a related rates problem.



7-28. Differentiate each function. [Homework Help](#)

a. $y = (6x)^{20}$

b. $y = \tan(6x)$


c. $y = \ln(6x)$

7-29. Use your results from problem 7-28 to integrate each expression below. What do each of the problems have common? [Homework Help](#) 

a. $\int (6x)^{19} dx$


b. $\int \sec^2(6x) dx$

c. $\int \frac{dx}{6x}$

7-30. Greta is trying to solve $x - 3\sqrt{x} = -2$. She decides to simplify the problem by letting $u = \sqrt{x}$. [Homework Help](#) 

a. Rewrite Greta's equation using u , then solve for u .

b. Suppose $x = 5$, what would u be?


7-31. Consider the curve $xe^{5y} = 3y$. [Homework Help](#) 


a. Find $\frac{dy}{dx}$.


b. Find the equation of the tangent line at $(0, 0)$.

c. If $x = 0.1$, estimate y using the tangent line.

d. Using $\frac{d^2y}{dx^2}$, determine if the tangent approximation is an over or under estimate. Justify your answer in words.

7-32. If Hoi Yin's hair is of length h , then explain what $\frac{dh}{dt}$ represents. Is it positive or negative? [Homework Help](#) 

7-33. A right triangle has a fixed hypotenuse of length 13 units. If a leg is increasing in length at a rate of $\frac{1}{2}$ unit per second, find the rate of change in area of the triangle when that same leg is 5 units long. [Homework Help](#) 

7-34. Without a calculator, determine the following limits. [Homework Help](#) 

a. $\lim_{x \rightarrow \infty} \left[4x + 2 - \frac{3}{x-2} \right]$



b. $\lim_{x \rightarrow -\infty} \frac{2x^2+x-21}{2x^2+5x-7}$

c. $\lim_{x \rightarrow 0^+} [\ln x + 18]$

d. $\lim_{x \rightarrow \frac{\pi}{3}} \frac{\sin x - \frac{\sqrt{3}}{2}}{x - \frac{\pi}{3}}$

7-35. In order to plan for the future water supply, the average population of the world is needed. If the world population in 2000 was about 6.1 billion people, determine the average population of the earth during the following 30 years. Assume the population, in billions, t years from 2000 is projected to be:

$$P(t) = 6.1e^{0.014t} \quad \text{Homework Help } \img alt="pencil icon" data-bbox="455 335 475 350"/>$$



7-36. Find the dimensions of the right triangle with hypotenuse of length 13 that has a maximum area.

[Homework Help](#) 