Activity 7.1‡ – Related Rates

FOR DISCUSSION: *What is a related rates problem?*

Practice solving the following problems by completing the steps outlined in Lesson 7.1.

- Draw a sketch labeled with variables.
- Find a "related variables" equation.
- Create a list of given information and identify the quantity you seek.
- Use implicit differentiation with respect to time to find a "related rates" equation.
- Substitute the given information into the rates equation and solve for the unknown.
- Write your answer with units.

1. A 13-ft ladder is leaning against a wall, and the bottom of the ladder is sliding away from the wall at a constant rate of 1 ft/s. How fast is the height of the top of the ladder changing when the bottom of the ladder is 12 feet from the wall?

2. Oil leaking from an offshore drilling rig spreads in a circle whose area is increasing at a constant rate of 4 mi^2/h. How fast is the radius of the spill increasing when the area reaches 10 mi^2?

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‡ This activity has supplemental exercises.

3. An air traffic controller is monitoring a jet that is passing directly overhead. The jet is flying horizontally at a constant height of 1 mile (5280 ft) above the control tower. At the moment the angle of elevation θ is 30° and decreasing, the horizontal speed of the jet is 400 ft/s. How fast is θ changing at this moment?

4. A spotlight on the ground is shining on a wall 12 meters away. A woman 2 meters tall walks from the spotlight toward the wall at a speed of 1.2 m/s. How fast is the length of her shadow changing when she is 6 meters from the wall? (**HINT**: Use similar triangles formed between the spotlight and the woman, and between the spotlight and the wall.)

5. A kite 50 feet above the ground moves horizontally at a speed of 2 ft/s. How fast does the string need to be let out when the angle of elevation of the kite is $\pi/6$ radians?

6. Suppose air expands in such a way that its pressure P and volume V are related by the equation $P \cdot V^{1.2} = C$, where C is a constant. Suppose that at a certain instant, the volume is 330 cubic centimeters and the pressure is 90 kiloPascals. If the pressure is decreasing at a rate of 10 kiloPascals per minute, then at what rate is the volume increasing at this instant? (Note that the lefthand side of the given equation is a product.)