Related Rates

A "related rates" problem is a problem which involves at least two changing quantities and asks you to figure out the rate at which one is changing given sufficient information on all of the others. For example, as two vehicles drive in different directions we should be able to deduce the speed at which they are separating if we know the individual speeds and directions.

In a *related rates* problem, we are given the rate of change of certain quantities, and are required to find the rate of change of related quantities.

Solving a Related Rates Problem

http://astro.ocis.temple.edu/~dhill001/relatedrates/relatedrates.html

Step 1: *Identify the changing quantities, possibly with the aid of a sketch.*
Step 2: *Write down an equation that relates the changing quantities.*
Step 3: *Differentiate both sides of the equation with respect to t.*
Step 4: *Go through the whole problem and restate it in terms of the quantities and their rates of change. Rephrase all statements regarding changing quantities using the phrase "the rate of change of . . . ."*
Last Step: *Substitute the given values in the derived equation you obtained above, and solve for the required quantity.*

Example 1:

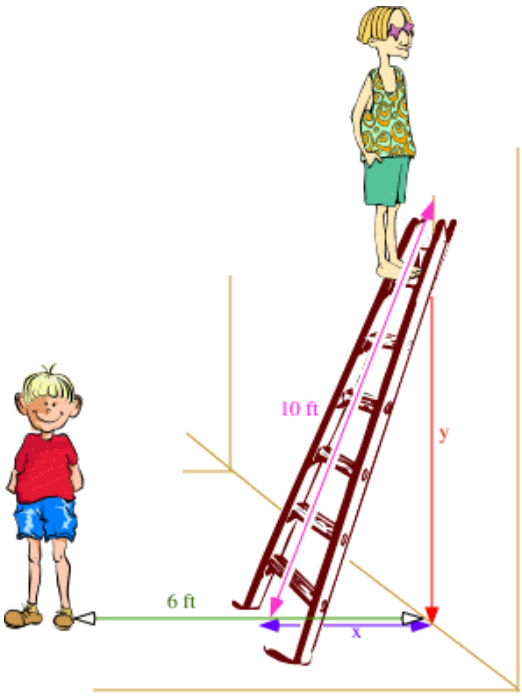
The area of a circular doggie puddle is growing at a rate of 12 cm^2/s. How fast is the radius growing at the instant when it equals 10 cm?

Example 2:

A spherical balloon is inflated so that its radius is increasing at a constant rate of 2 cm/s. At what rate is air being blown into the balloon when its radius is 5 cm?

Example 3:

Mike is perched precariously at the top of a 10-foot ladder leaning against the back wall of an apartment building (spying on an enemy of his) when it starts to slide down the wall at a rate of 3 ft per minute. Mike's accomplice, Lou, is standing on the ground 6 ft. away from the wall. How fast is the base of the ladder moving when it hits Lou?*)*



Example 4:

A kite 100 feet above the ground moves horizontally at a speed of 8 feet per second. At what rate is the angle between the string and the horizontal decreasing when 200 feet of string have been let out?

Example 5:

Two cars start moving from the same point. One travels south at 25 mph and the other travels

Example 6

A water tank is in the shape of a cone (with the pointed side down) which has a height of 10 feet and a radius of 5 feet. Water runs into the tank at a constant rate of 2 cubic feet per minute. How fast is the water level rising when the height of the water is 4 feet?