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Math 31A Lecture Notes: Related Rates

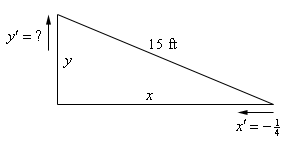
Example 1:  Air is being pumped into a spherical balloon at a rate of 5 cm3/min.  Determine the rate at which the radius of the balloon is increasing when the diameter of the balloon is 20 cm.

Step 1: Differentiate the formula

Step 2: Substitute known values

Step 3: Solve for

Example 2: A 15-foot ladder is resting against the wall. The bottom is initially 10 feet away from the wall and is being pushed towards the wall at a rate of . How fast is the top of the ladder moving up the wall 12 seconds after we start pushing?



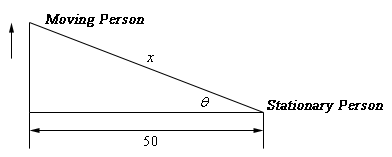
Step 1: Differentiate the formula

Step 2: Find x at 12 second

Step 3: Find y

Step 4: Substitute known values

Example 3: Two people are 50 feet apart. One of them starts walking north at a rate so that the angle shown in the diagram below is changing at a constant rate of 0.01 rad/min. At what rate is the distance between the people changing when θ = 0.5 radians?

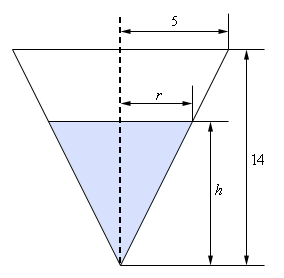


Step 1: Apply trig formulas

Step 2: Differentiate the formula

Step 3: Substitute known values

Example 4: A tank of water in the shape of a cone is leaking at a constant rate of . The base radius of the tank is 5 ft. and the height of the tank is 14 ft.



1. At what rate is the depth of the water in the tank changing when the depth of the water is 6 ft.?

Step 1: Find r using proportions

Step 2: Substitute known values

Step 3: Differentiate the formula

Step 4: Find

Step 5: Solution The height is decreasing at the rate of 0.1386 ft/hr.

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1. At what rate is the radius of the top of the water in the tank changing when the depth of the water is 6 ft.?

Step 1: Find r using proportions

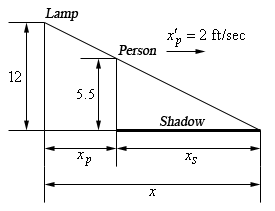
Step 2: Substitute known values

Step 3: Differentiate the formula

Step 4: Find

Step 5: Solution The radius of the top of the water decreases at the rate of 0.04951 ft/hr.

Example 5: A light is on the top of a 12-ft. tall pole and a 5’6” tall person is walking away from the pole at a rate of 2 ft./sec.



1. At what rate is the tip of the shadow moving away from the pole when the person is 25 ft. from the pole?

Step 1: Apply proportions to get xs

Step 2: Solve for x­s

Step 3: Apply xs to the equation

Step 4: Differentiate the formula

1. At what rate is the tip of the shadow moving away from the person when the person is 25 ft. from the pole?

Step 1: Differentiate the formula

Step 2: Substitute known values

Step 3: Solution The tip of the shadow is moving away from the person at the rate of 1.6923 ft./sec.