

# Related Rates Lecture Problems

## Example 1

A snowball melts so that its surface area is decreasing a rate of 1 squared centimeter per minute. Find the rate at which the diameter is changing when the diameter is 10 centimeters.

## Example 2

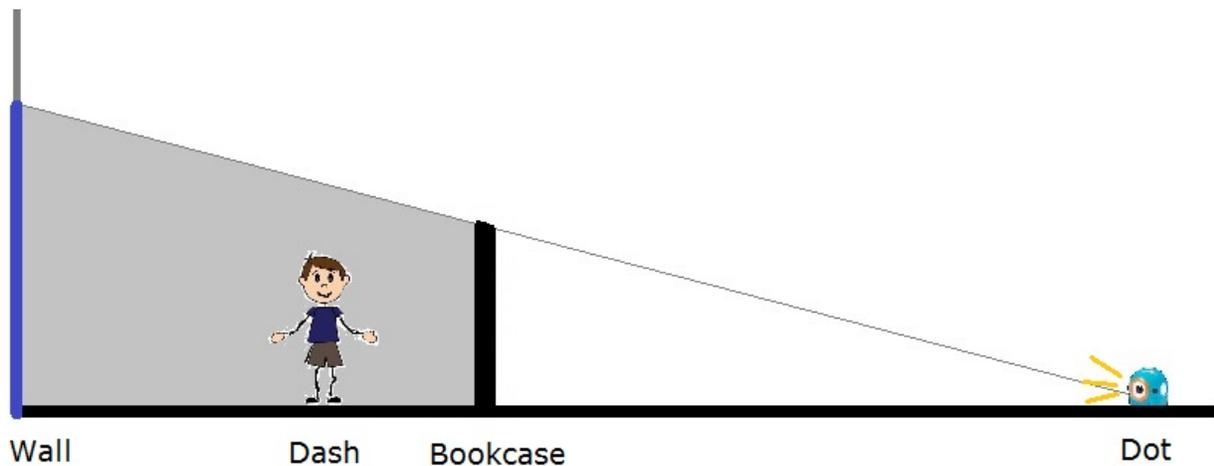
A weather balloon which is rising vertically is observed from a point on the ground 300 feet from the spot directly beneath it. At what rate is the balloon rising when the angle between the ground and the observer's line of sight is  $45^\circ$  and increasing at  $1^\circ$  per second?

### **Example 3 - three quantities changing**

Two cars start moving from the same point. One travels South at 60 miles per hour. The other goes West at 25 miles per hour. At what rate is the distance between them changing two hours after they start?

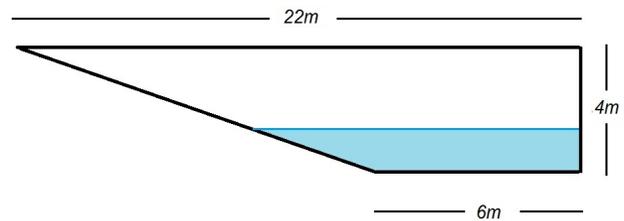
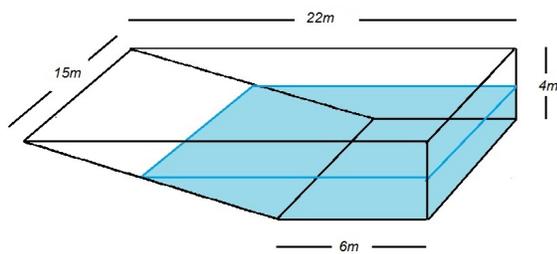
## Example 4 - Spring '16 Midterm 2 Question

Dash is standing between a wall and a 1.5 meter high book case which is 5 meters away from the wall. On the other side of the bookcase is his robot Dot with a lamp attached. Dot is moving towards the bookcase and Dash is trying to compute the speed of Dot from the height of the shadow the bookcase casts on the wall. How fast is Dot moving when the shadow of the book case on the wall is 3 meters and increasing at rate of 1.3 meters per second?



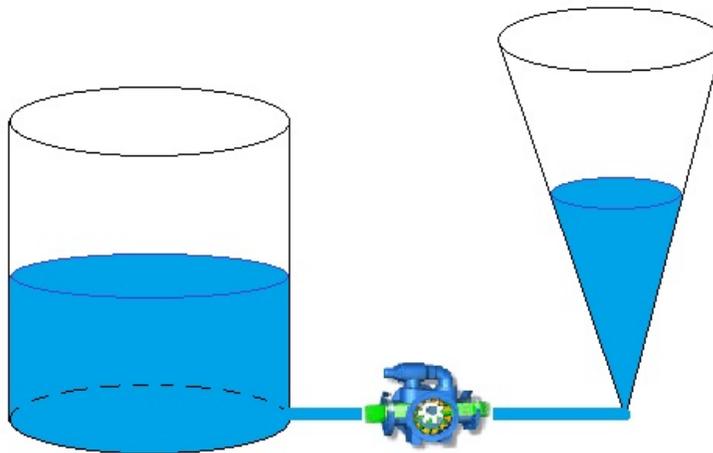
## Example 6 - Fall '16 Final Question

A pool is 15 meters wide and 22 meters long. The cross section is in the shape of a right trapezoid, one of the parallel sides being the length of the pool, and the other one equal to 6 meters. At its deepest point the pool is 4 meters deep. The pool and its cross section are pictured below. Water is pumped into the pool at a rate of 7 cubic meters per minute. How fast is the water level rising when the water level is 3 meters measured at its deepest end?



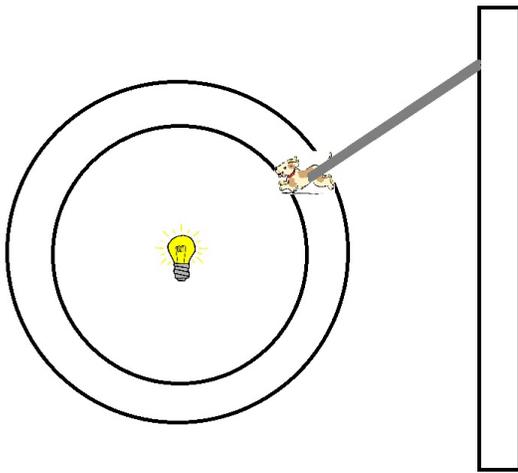
## Example 7 - Fall '11 Midterm 2 Question

Two tanks, one shaped like a cylinder, the other like an inverted cone are connected by a pipe. The cylindrical tank has radius 0.5 meters and a height of 3 meters. Initially it is full. The conical tank has radius 0.4 meters and a height of 4 meters. Water is pumped from the cylindrical tank into the conical tank. If the level of the water  $y$  in the cylindrical tank is falling at a rate of 0.1 meters per minute, at what rate is the water level  $h$  rising in the conical tank when the water level is 1.5 meters in the conical tank? Hint: The total volume of water in the system remains constant and the volume of a cone is a third of base area times its height.



### Example 8 - Fall '15 Final Question

Chetna is racing around a circular track, starting at the easternmost edge and running counterclockwise at a constant pace of 40 seconds per lap. At the center of the track is a lamp, and 60 meters east of the lamp is a wall that runs north-south. When Chetna is one-twelfth of the way around the track, how fast is her shadow moving along the wall?



### Example 9 - Fall '15 Final Question

One end of a rigid rod of length 3 feet is attached to a wheel of radius 1 foot, centered at the origin. The wheel is free to rotate about the origin. As the wheel rotates, the right end of the rod slides along the  $x$ -axis. Suppose that when  $\theta = \pi/3$ , the right end of the rod is moving to the right at a rate of 0.5 ft/sec. How fast is  $\theta$  changing when  $\theta = \pi/3$ ?

