

## Homework 10

1. A large rock is released from rest into a lake and allowed to drop. The rock's acceleration after  $t$  seconds is  $a = -6.54e^{-0.7t}$  m/s<sup>2</sup>.

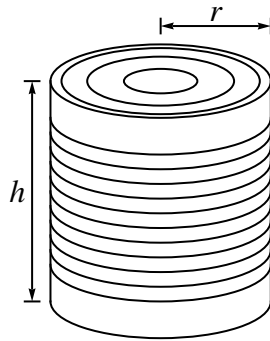
(a) Determine the velocity of the rock after  $t$  seconds.

(b) What is the rock's depth after  $t$  seconds?

(c) How many seconds does it take for the rock to sink 300 meters?

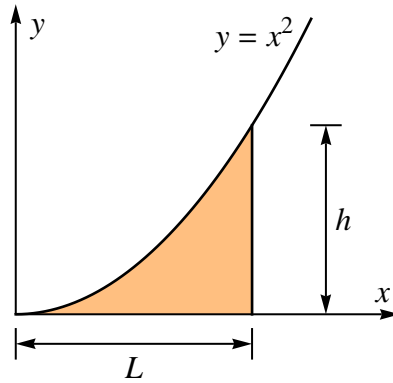
(d) What is the eventual velocity of the rock (as  $t \rightarrow \infty$ )?

2. Consider a tin can with radius  $r = 3$  cm and height  $h = 15$  cm.



The side of the can has a thickness of 0.1 mm, while the top and bottom have a thickness of 0.2 mm.  
Estimate the total volume of metal used to make the can.

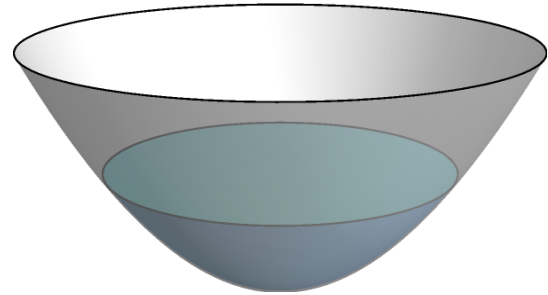
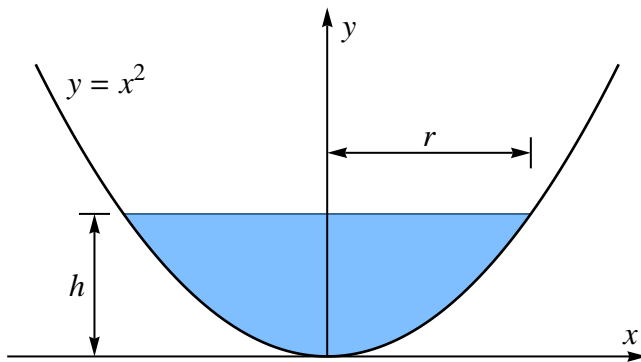
3. The following figure shows the region under the graph of  $y = x^2$  from  $x = 0$  to  $x = L$ .



Let  $h$  be the height of the region, and let  $A$  be the area.

- (a) Find a formula for the height  $h$  in terms of the length  $L$ .
- (b) Suppose we increase  $L$  by a small amount  $dL$ , causing the area  $A$  to increase by a small amount  $dA$ . Find a formula for  $dA$  in terms of  $L$  and  $dL$ .
- (c) Divide through by  $dL$  to obtain a formula for  $\frac{dA}{dL}$ .
- (d) Use your answer to part (c) to find a formula for the area  $A$  in terms of the length  $L$ .

4. A bowl with the shape of a parabola is partially filled with water.



(a) Find a formula for the radius  $r$  of the water in terms of its height  $h$ .

(b) Suppose we pour slightly more water into the bowl, increasing the height by a small amount  $dh$ . Find a formula for the volume  $dV$  of water that was added in terms of  $h$  and  $dh$ .

(c) Use your answer to part (b) to find a formula for the volume  $V$  of the water in terms of the height  $h$ .