

## Worksheet Flabbergasted

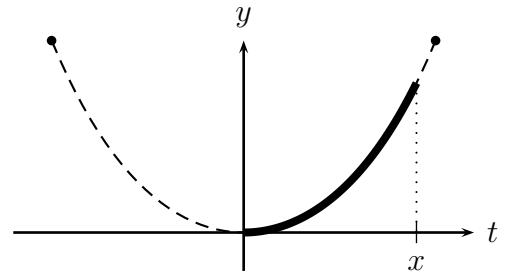
1. Recall that last time we found that the length of a curve  $y = f(x)$  from  $a$  to  $b$  is

$$\int_a^b \sqrt{1 + f'(x)^2} dx.$$

Find the length of  $y = x^{3/2}$  from  $x = 0$  to  $x = 1$ .

2. In our quest to determine the shape of a hanging chain, we have found that the forces on a portion of the chain obey a certain relationship: if  $m(x)$  is the mass of the chain between the middle and position  $x$ ,  $T_0$  is the tension in the chain at the bottom, and  $y = F(x)$  is the shape of the chain, then in order to make the forces balance we must have:

$$\frac{m(x)g}{T_0} = F'(x).$$

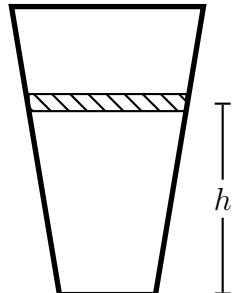


- (a) How could you calculate  $m(x)$  if you knew  $F(x)$ ?  
 (b) Some of that we know how to do. Use it to modify the equation above. Feel free to combine unknown constants into one, and simplify as much as possible.
3. Evaluate  $\int_{-\pi}^{\pi} \sin(mx) \cos(nx)$  where  $m$  and  $n$  are positive integers. Hint:

$$\begin{aligned}\sin(u+v) &= \sin u \cos v + \cos u \sin v \\ \sin(u-v) &= \sin u \cos v - \cos u \sin v\end{aligned}$$

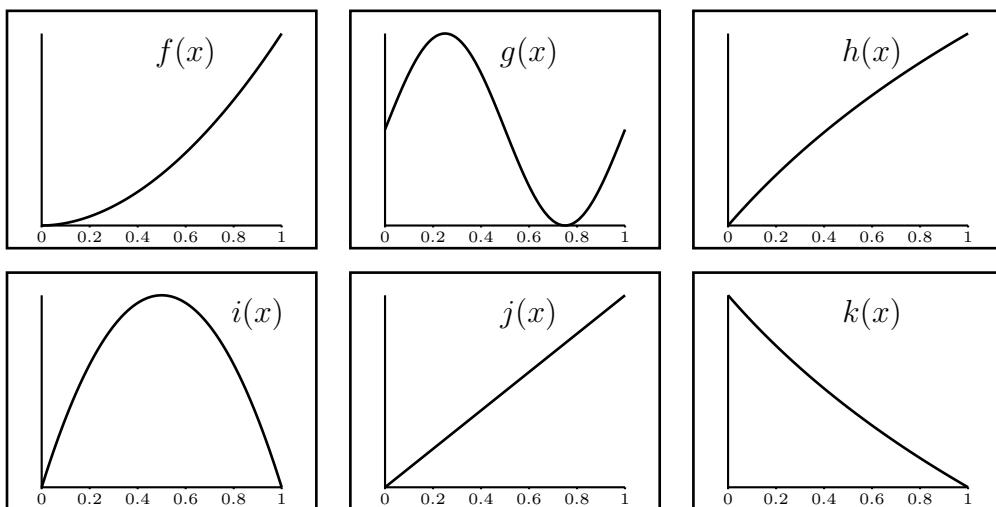
4. Suppose a Solo cup has radii  $R_1$  cm and  $R_2$  cm and height  $H$  cm.

- (a) Consider a disk-shaped slice of the cup which is a height  $h$  above the bottom. What is its radius, in terms of  $h$ ? Hint: The sides of the cup are straight, so the radius is a linear function of  $h$ .  
 (b) If the thickness of the disk is  $\Delta h$ , what is its volume?  
 (c) Suppose the cup is filled with water, which has density of  $\delta$  kg/cm<sup>3</sup>. How much does the slice weigh?  
 (d) Find the center of mass of the water in the cup.

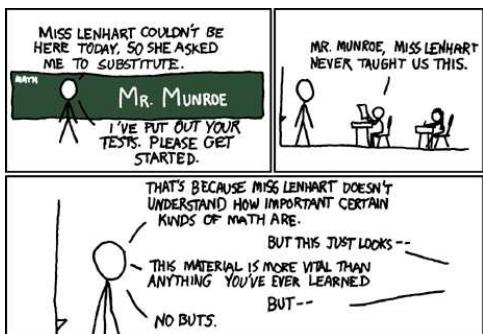
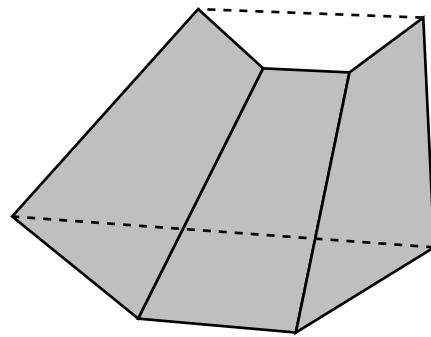


5. Below are the graphs of several functions  $f(x)$ ,  $g(x)$ ,  $h(x)$ ,  $i(x)$ ,  $j(x)$ , and  $k(x)$ . Do not assume that the  $y$ -axis scales on these graphs are equal or even comparable. We have calculated LEFT(6), RIGHT(6), TRAP(6), and MID(6) for four of these six functions. Label each column with the name of the function estimated in that column.

Function:				
LEFT(6):	64.2	.328	.255	80.0
RIGHT(6):	65.8	.444	.421	80.0
TRAP(6):	65.0	.386	.338	80.0
MID(6):	65.0	.388	.331	80.0



6. The picture to the right shows a section of the Los Angeles river, whose sides are lined with concrete. It is currently full of water, but we need to empty it so we can film a car chase scene for a movie (as in *Terminator 2*, *Grease*, *Gone in 60 Seconds*, *Buckaroo Banzai*, etc.) It is 100 meters long, 17 meters deep, 40 meters wide at the top and 20 meters wide at the bottom. Find the work required to pump all the water up to the top of the river.



1. The velociraptor spots you 40 meters away and attacks, accelerating at  $4 \text{ m/s}^2$  up to its top speed of 25 m/s. When it spots you, you begin to flee, quickly reaching your top speed of 6 m/s. How far can you get before you're caught and devoured?

