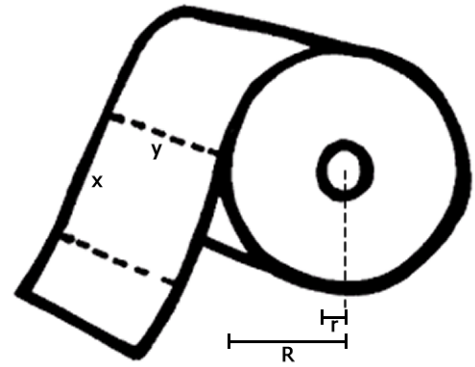


**Part 1: The diagram below describes a toilet paper roll.**

The dimension of each sheet of toilet paper are  $x$  by  $y$ . The radius of the inner cardboard cylinder, shown as  $r$  in the diagram, is 0.5 inches. The radius of the entire cylinder, shown as  $R$  in the diagram, is 2.25 inches. The standard roll is 4.5 inches by 4.5 inches.



$$\text{Circle} \quad A = \pi \cdot \text{radius}^2$$

$$\text{Volume of Cylinder} \quad V = \pi \cdot \text{height} \cdot \text{radius}^2$$

1. Find the volume of the inner cylinder (the cardboard tube):
2. Find the volume of the outer cylinder (the whole roll with nothing missing in the center):
3. The volume of the actual toilet paper is the difference between the outer cylinder and the inner cylinder. Find this volume.
4. Company Shady-Dealers wants to change the dimensions of the roll so it appears the exact same size (4.5 inches by 4.5 inches) but actually has less toilet paper. This change will provide less product for the consumer but save money for the company (more profit). Given the dimensions  $x$ ,  $y$ ,  $r$ , and  $R$  in the diagram above, what dimension should Shady-Dealers change to achieve their dubious goal? Describe in depth.

Toilet paper has perforated lines to make tearing easier. The lines make the toilet paper look like a series of attached squares. The squares are called sheets and the dimensions in the shape above for each sheet is  $x$  by  $y$ . In a standard roll, the sheets are squares with side length 4.5 inches.

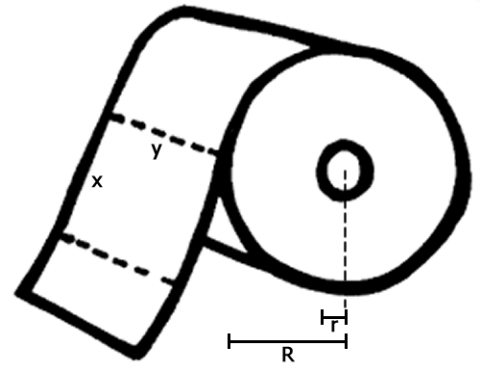
5. If 10 sheets are attached side by side, then what are the dimensions of the attached sheets AND what is the area?
6. Company Shady-Dealers is attempting to deceive the consumers with their advertising. They wish to sell the exact same volume of toilet paper as their existing product, but they wish to make the following claim:

“Shady Dealer Rolls now include 40% more sheets per roll than our leading competitor”

Given the dimensions  $x$ ,  $y$ ,  $r$ , and  $R$  in the diagram above, what dimension should Shady-Dealers change to achieve their dubious goal? Describe in depth.

**Part 2: The diagram below describes a toilet paper roll.**

The dimension of each sheet of toilet paper are  $x$  by  $y$ .  
 The radius of the inner cardboard cylinder, shown as  $r$  in the diagram, is 0.5 inches. The radius of the entire cylinder, shown as  $R$  in the diagram, is 2.25 inches. **The standard roll is 4.5 inches by 4.5 inches.**



Circle  $A = \pi \cdot \text{radius}^2$

Volume of Cylinder  $V = \pi \cdot \text{height} \cdot \text{radius}^2$

Good Toilet Paper Company plans to sell **24 rolls in a package**.

The picture at the right shows one possible arrangement for the rolls in which each level includes 6 rolls (2 by 3).



7. How many levels are required for the arrangement pictured?
8. State the length, width, and height for the package.

The package is closest in shape to a rectangular prism.  
 The volume of the shape is  $V = l \cdot w \cdot h$ .

9. Find the volume of the package shown in the diagram.

10. Complete the following table by creating different arrangements of rolls that can create a 24 roll package (integer values only for rolls). Each arrangement will be assigned a new row in the table. Not all rows must be filled. The first row shows values from the picture. Try to find all possible arrangements.

Arrangement Number	Width in Rolls	Width in Inches	Length in Rolls	Length in Inches	Height in Rolls	Height in Inches	Volume of Package
1	2		3				
2							
3							
4							
5							
6							
7							
8							
9							
10							

11. Using your table above, what arrangements do you feel Good Toilet Paper Company should use for their package? Explain using values from the table.