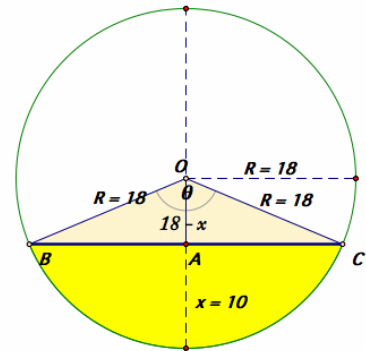
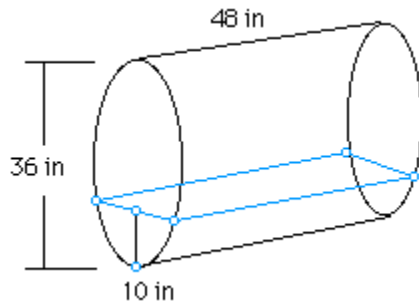


## Problems with Cylindrical Tanks

Problem:



This problem was seriously proposed to one of my students in this course by their Superintendent. At the Superintendent's home the furnace used fuel oil stored in an underground tank. It was known that the tank was installed level on its side and that it was 36 inches in diameter and 48 inches long. Using a stick dipped through the fill tube, the superintendent determined he had 10 inches of oil in the tank. He really did NOT want to know how to calculate the amount of oil. He knew from experience that it was February and he would need about 40 gallons of oil to finish the season. Would he have enough oil?

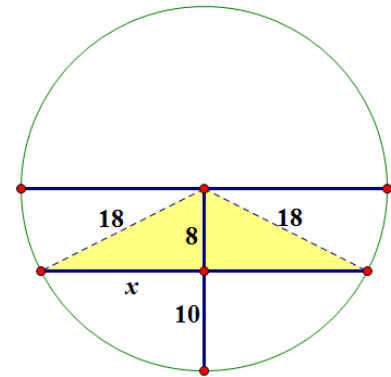
Solution:

First we will calculate the area of the sector between two dotted lines and then subtract the area of the triangle.

Note: 1 cubic inch = 0.004329 gallon

For area of the sector,

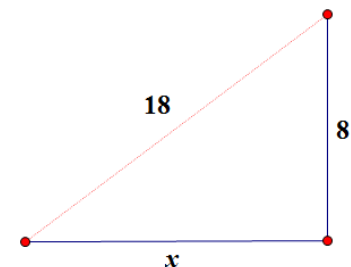
$$\begin{aligned}\cos\left(\frac{\theta}{2}\right) &= \frac{8}{18} \\ \frac{\theta}{2} &= \cos^{-1}\left(\frac{8}{18}\right) \\ \frac{\theta}{2} &\approx 1.11 \\ \theta &= 2.22\end{aligned}$$



So, area of sector,  $\frac{\theta r^2}{2} = \frac{2.22 \cdot (18)^2}{2} \approx 359.64 \text{ in}^2$

Now, for area of triangle,  $8^2 + x^2 = 18^2$   
 $x^2 = 18^2 - 8^2 = 260$   
 $x = \sqrt{260}$

So, area of triangle =  $\frac{1}{2}(2\sqrt{260})(8) \approx 129 \text{ in}^2$ .



So, the surface area of the tank with oil =  $359.63 - 129 = 230.63 \text{ in}^2$

Hence, the volume of the tank with oil =  $(230.63 \text{ in}^2)(48 \text{ in}) = 11070.24 \text{ in}^3$

The amount of oil remaining on the tank =  $(11070.24 \text{ in}^3) \left(0.0043 \frac{\text{gallon}}{\text{in}^3}\right) \approx 47.6 \text{ gallons}$ .

Hence, the amount of oil remaining will be enough to finish the season.