7. [15 points] Consider a piston that compresses a closed cylinder of gas, as shown in the figure to the right, below. If the volume of the gas in the cylinder is $V$, then the force required to move the piston and compress the gas is $F = \frac{k}{V}$, where $k$ is a constant. The uncompressed length of the gas cylinder is 2 ft and its radius is $\frac{1}{4}$ ft. Let $x$ be the distance that the piston has moved to compress the gas. (Note that the volume of a cylinder with radius $r$ and height $h$ is $\pi r^2 h$.)

a. [5 points] Find an expression for $F(x)$, the force as a function of $x$. If $F(0) = 200$ lb, find $k$.

b. [10 points] Find the work to compress the gas from $x = 0$ to $x = \frac{3}{2}$. 