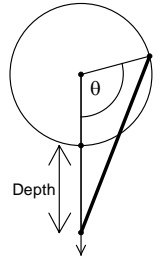


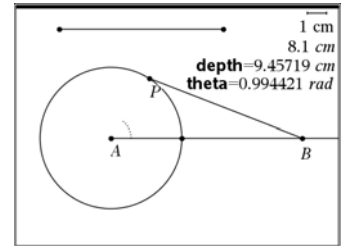
Solving the Piston Problem

A *piston*, in essence, is a rod with one end that moves around a fixed circle (think: attached to a rotating wheel or axle) and another that moves along a fixed line (think: cylinder), as at right. The question we're going to investigate is how the depth depends on the amount of rotation (θ in the diagram at right).



Before you start, you need to get the **PistonProblem** document from one of your classmates. Link your calculator to theirs. On the [sending](#) calculator, press $\text{[link]} \text{[7]}$ to get the list of documents, select **PistonProblem**, and press $\text{[ctrl]} \text{[link]} \text{[1]} \text{[5]}$ to send the document to your calculator.

Step 1: Play around with the piston and get a sense for how the depth depends on the angle. Which angles provide maximum depth? Minimum depth?



Step 2: Make a new spreadsheet (in the same problem). Label column A **angmeas** and label column B **length**. Select column A, go to $\text{[menu]} \rightarrow \text{Data} \rightarrow \text{Data Capture}$, select **Automatic**, and type in **theta**. Select column B, go to $\text{[menu]} \rightarrow \text{Data} \rightarrow \text{Data Capture}$, select **Automatic**, and type in **depth**.

A	angmeas	B	length	C	D
1	0.994421		9.45719		
2					
3					
4					
5					
6					
B1		=9.4571877455797			

Step 3: Now go back to the previous page and start dragging point P around the circle. What happens to your spreadsheet?

Step 4: Create a new Data and Statistics page and graph **length** on the y -axis versus **angmeas** on the x -axis. What shape is the graph?

Step 5: For some mysterious reason, Fathom won't let you do a sinusoidal regression on the data. But you can make your own function by determining the period, amplitude, phase shift, and vertical shift. Do that, writing the values below (hint: look in the spreadsheet!). Then find a formula for the function:

Period: _____ Amplitude: _____ Phase Shift: _____ Vertical Shift: _____

Formula: _____

Step 6: Add your function plot to the scatterplot. Does it fit well? In what ways does the fit seem imperfect? Give a few specific sentences of explanation, and a sketch of the graph.