

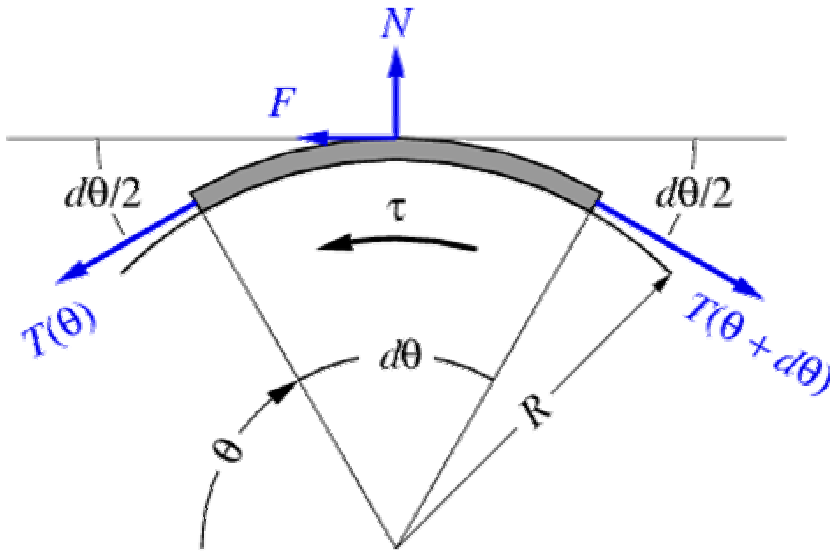


MIT

8.01T Physics I

Experiment 5B: Friction

Goal

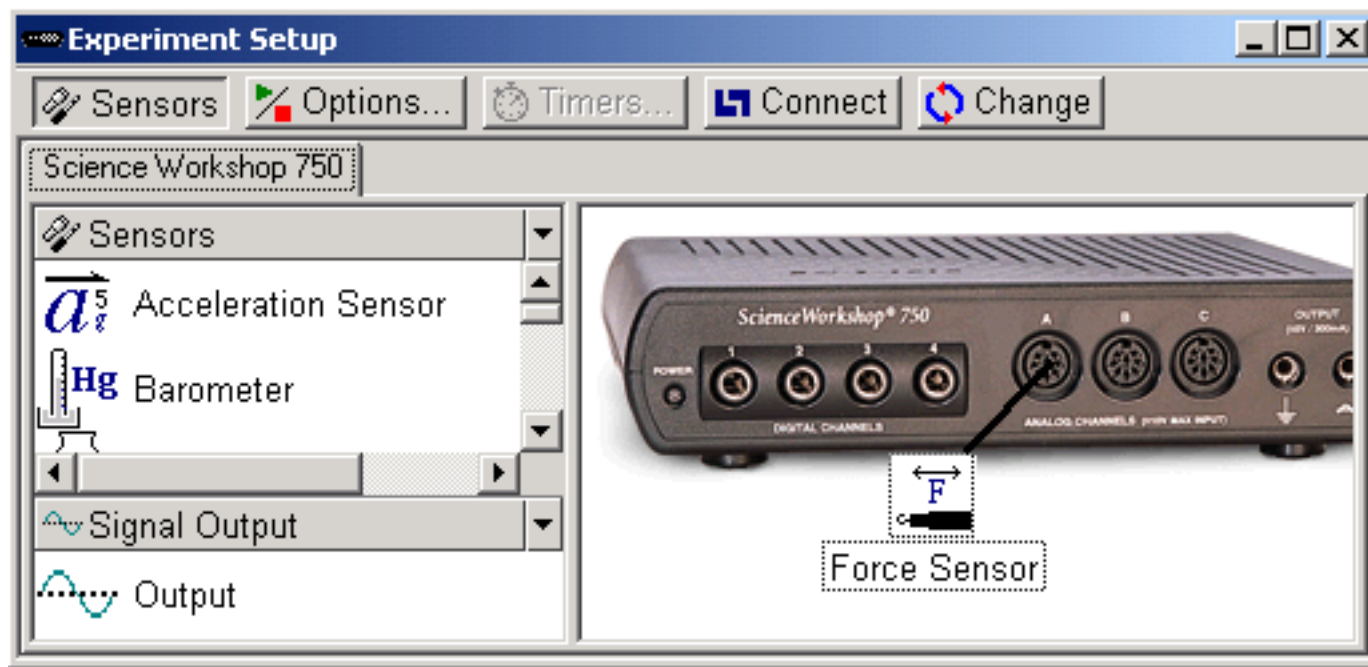


To investigate the friction of a string wrapped around a cylinder, observe that it increases exponentially, and to measure the friction coefficient μ .

(A theoretical expression is derived in the appendix to the write up for the experiment.)

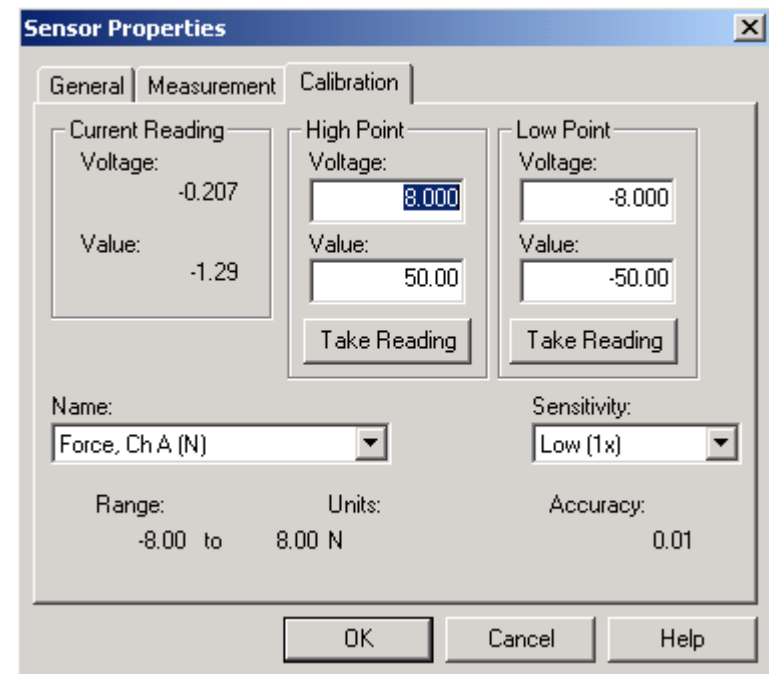
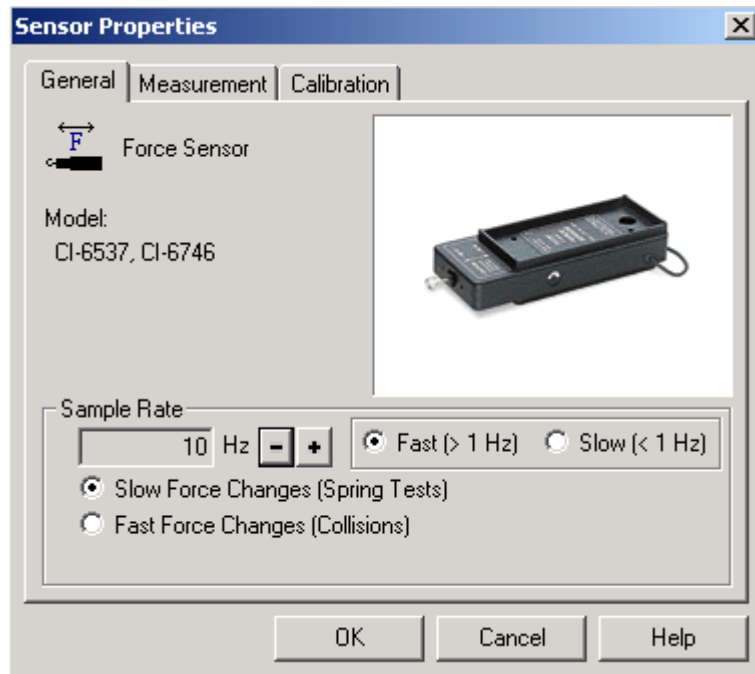
Starting *DataStudio*:

Create a new experiment. Plug a force sensor into the drag it to the input in the Setup window.



Double-click the Force Sensor icon.

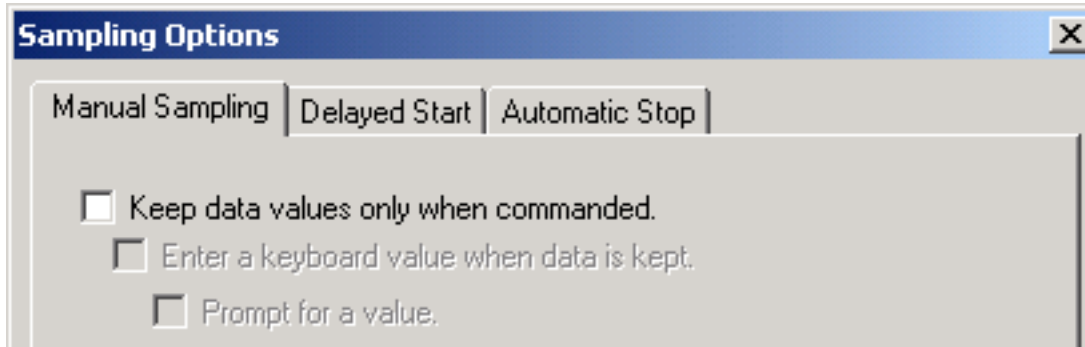
Force Sensor:



Set it for 10 samples/s and low sensitivity.

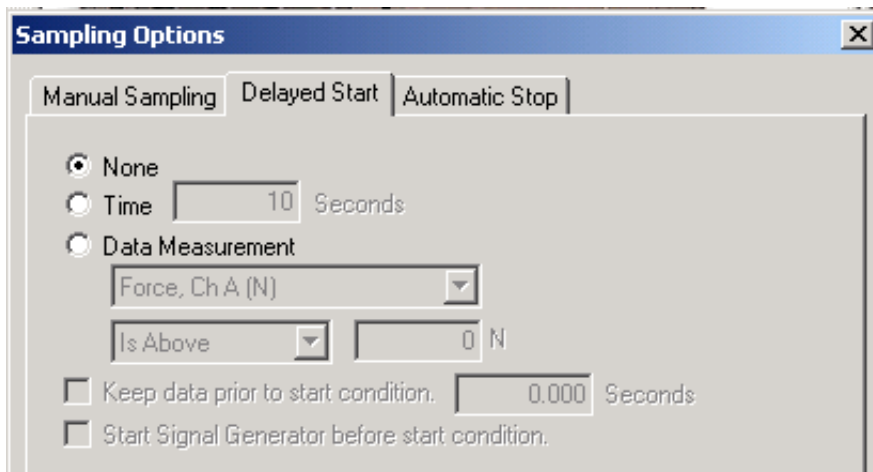
Click  Options...

Sampling Options:



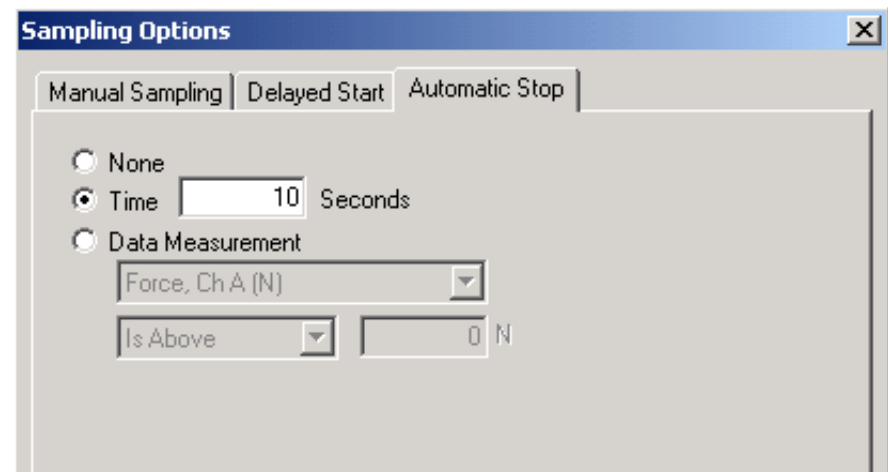
The dialog box titled "Sampling Options" has three tabs: "Manual Sampling", "Delayed Start", and "Automatic Stop". The "Manual Sampling" tab is selected. It contains three unchecked checkboxes: "Keep data values only when commanded.", "Enter a keyboard value when data is kept.", and "Prompt for a value."

No boxes checked.



The dialog box titled "Sampling Options" has three tabs: "Manual Sampling", "Delayed Start", and "Automatic Stop". The "Manual Sampling" tab is selected. It contains three radio buttons: "None" (selected), "Time" (with a value of 10 Seconds), and "Data Measurement" (with a dropdown menu showing "Force, Ch A (N)", a "Is Above" dropdown, and a value of 0 N). Below these are two unchecked checkboxes: "Keep data prior to start condition." (with a value of 0.000 Seconds) and "Start Signal Generator before start condition."

No delayed start.



The dialog box titled "Sampling Options" has three tabs: "Manual Sampling", "Delayed Start", and "Automatic Stop". The "Manual Sampling" tab is selected. It contains three radio buttons: "None", "Time" (selected, with a value of 10 Seconds), and "Data Measurement" (with a dropdown menu showing "Force, Ch A (N)", a "Is Above" dropdown, and a value of 0 N).

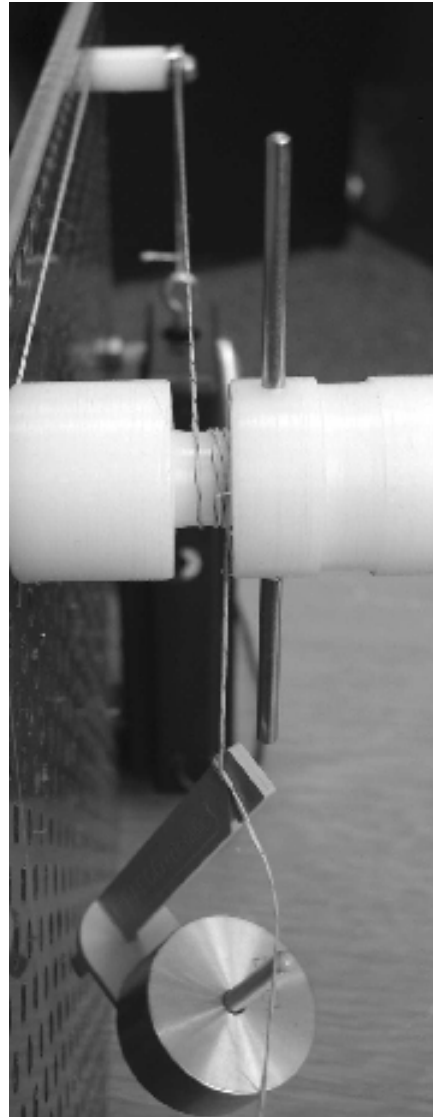
Stop after 10 s.

Set Up :

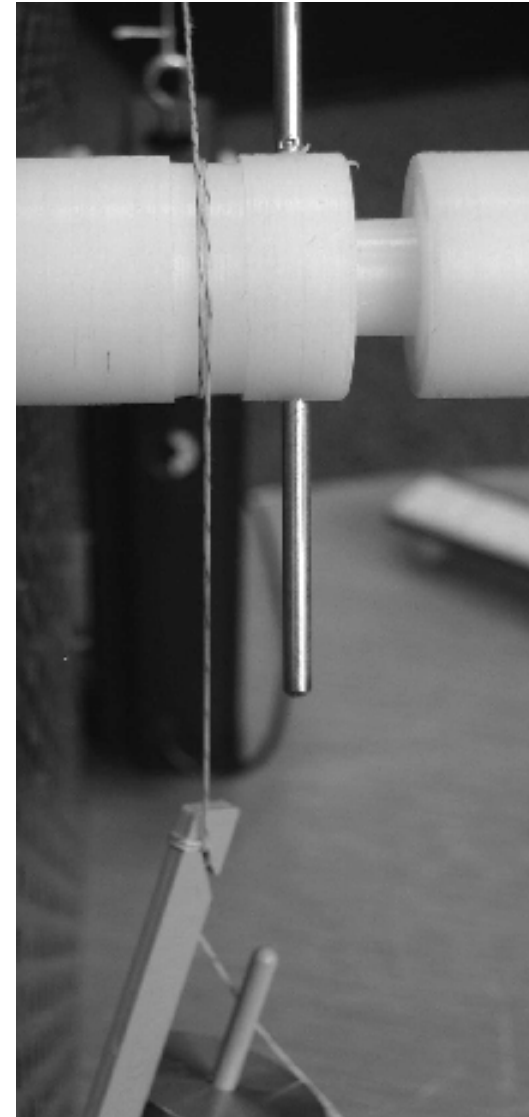
Choose large or small cylinder.

Both kinds at each table.

100 gm brass weight + 5 gm holder = 1.03 N.



Small Cylinder



Large Cylinder

Measuring technique:

Tare the force sensor.

Ensure string passes over pulley before all measurements.

Do not wrap the string over itself.

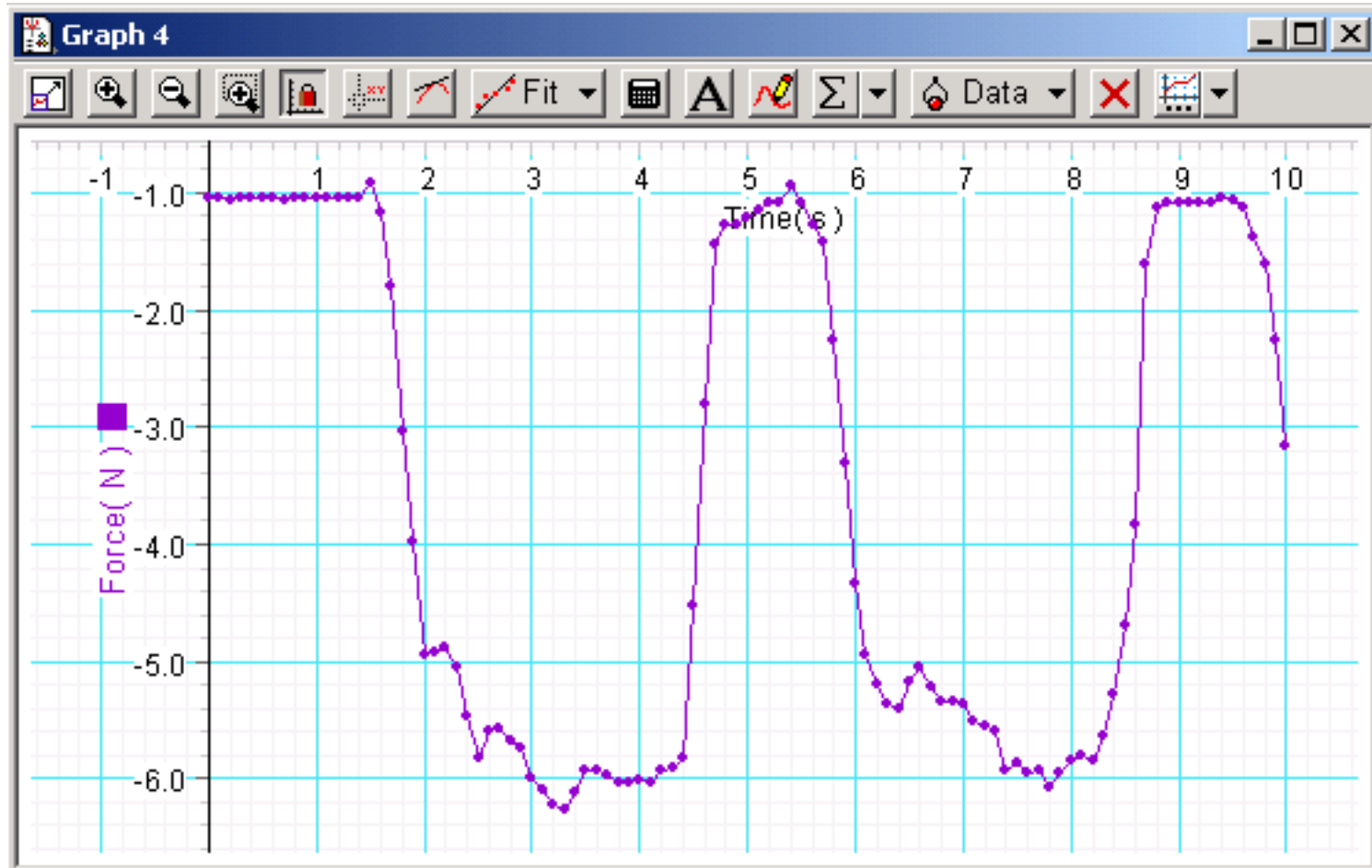
Wrap string $2\frac{1}{4}$ turns around cylinder.



Increase ccw torque on cylinder smoothly to the slipping point, then turn slowly for 1 or 2 seconds.

Practice this, so you get 1 or 2 peaks of the force in 10 s, then record the force with *DataStudio*.

Measuring the Friction:



Choose the largest magnitude of Force as the friction.
Use the Smart Tool or the Statistics (Σ) Tool.

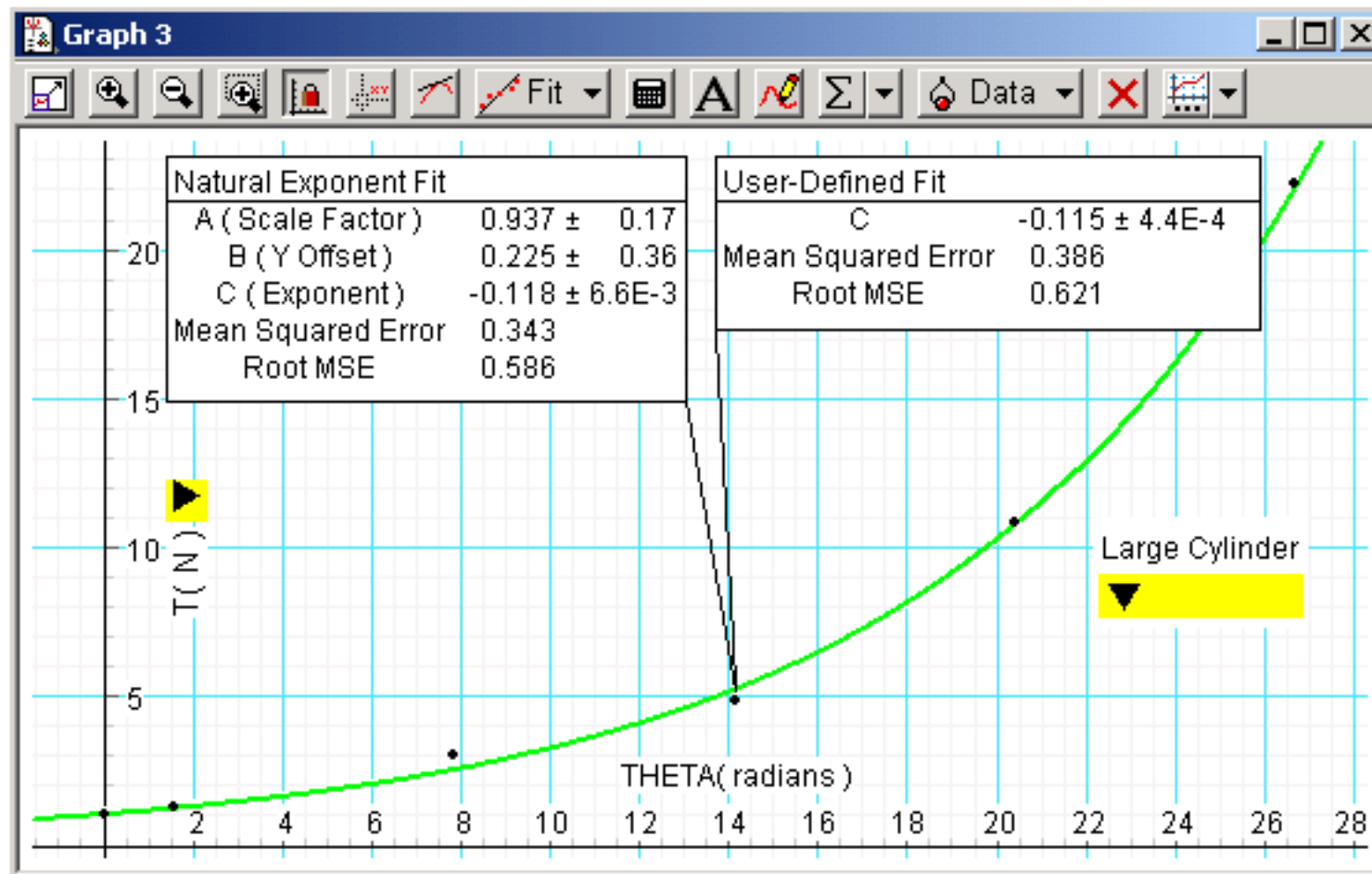
Recording the Friction:

Measure the friction for the string wrapped $\frac{1}{4}$, $1\frac{1}{4}$, $2\frac{1}{4}$, $3\frac{1}{4}$ and $4\frac{1}{4}$ turns. Express these in radians and type them as the independent variable, along with the friction force as the dependent variable, into a table in DataStudio.

Include the force of 1.03 N when the wrap angle is 0 as an entry in your table.

Plot the table on a graph and carry out a User-Defined Fit with the function $1.03 * \exp(-C * x)$.

Fit Result (large cylinder):



Fit Result (small cylinder):

