Form 6S Physics Practical
Experiment A : Investigation of Friction

Purpose:
In this experiment, students determine the coefficients of static and kinetic friction and derive the equations for static and kinetic friction.

Equipment:
- GLX
- Force Sensor
- Wooden Block with Hook
- Triple-Beam Balance
- Slotted Masses
- String

Data Collection Procedure:

1. Using a balance, determine the mass of the Wooden Block : _____ kg

2. Place a 200 g mass in the Wooden Block. Find the combined mass of the Wooden Block with the 200 g mass. Enter the value into the Data Table below.
3. Calculate the Normal reaction of the Wooden Block with the mass. Enter the value into the Data Table.
4. Set up the equipment as in the picture above (except the Motion Sensor).
5. Press the ▶ button on the GLX.

6. Gently pull the Force Sensor with a slowly increasing force. You should be as gentle as possible. (You should see the Force-time graph in the GLX slowly rising at the beginning.) Then up to some point, the block starts moving then try to adjust your force so that the block keeps moving at constant velocity for 5 more seconds.

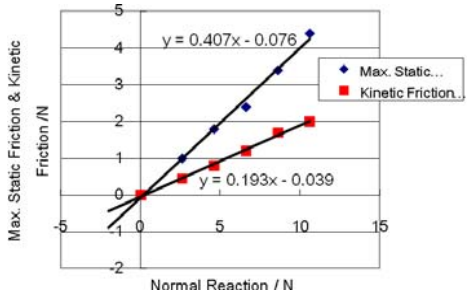
7. Observe the graph. When the velocity remains fairly constant, press the ▶ button.
8. Press F3 and select the Smart Tool. Use the Smart Tool to find the maximum static frictional force. Enter this value into the Data Table.
9. Use the arrows to move the cursor to the beginning of the period in which the Wooden Block experiences constant velocity and press F3 and select the Delta Tool. Then move the cursor to the end of that period and press F3 again to select the Statistics Tool. Enter the average value of the force for this region as the Kinetic Friction into the Data Table.

10. Repeat the previous steps with the addition of another mass (200g each time) until the data table is completed.

Data Table 1: Maximum Static Friction (teacher's sample data)

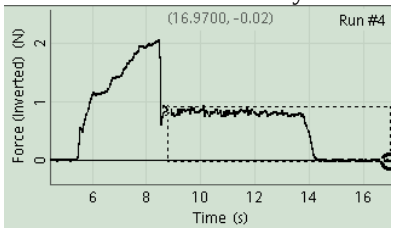
Mass (kg)	F_N Normal reaction (N)	F_s Max. Static Friction (N)	F_k Kinetic Friction (N)
0.2605	2.605	1	0.45
0.4605	4.605	1.8	0.80
0.6605	6.605	2.4	1.2
0.8605	8.605	3.4	1.7
1.0605	10.605	4.4	2.0

Analysis
1. Plot and label a graph with Normal reaction on the horizontal axis and Static Friction on the vertical axis.
2. Plot and label a graph with Normal reaction on the horizontal axis and Kinetic Friction on the vertical axis.



Questions:

1. Sketch or print-out the Force-Time graph.
   Label the following regions on the Force-Time graph:
   A) A force is being applied and the mass is NOT moving.
   B) A force is being applied just before the mass moves.
   C) A force is being applied and the mass accelerates.
   D) A force is being applied and the mass moves with a non-zero constant velocity.



2. Draw labeled force diagrams for each of the regions mentioned above. Make sure to draw the vectors in the force diagrams with lengths relative to their values. For example, if one force is twice the value of another, its vector should be twice as long.

3. What do the slopes of the Friction versus Normal reaction graphs represent physically?

4. Write a y=mx+b equation for each Friction graph with the appropriate variables and units.

Extension:
Repeat the experiment with a different surface supporting the wooden block. Relate and explain the differences in the slopes of the Static Friction and Kinetic Friction graphs to the type of surfaces beneath each Wooden Block.