Simple Harmonic Motion        Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Purpose: Investigate a simple harmonic motion.

Apparatus: PC, interface, motion sensor, plumb-line, meter stick, hard spring, mass hanger, mass set, pendulum clamp, and electronic balance.

Theory:   
  
A mass, *m* is attached to the end of an elastic spring of spring constant, *k* and made to oscillate in simple harmonic motion of amplitude, *xm* and period, *T*.  
 The displacement is given by, , where .  
 The period (in terms of mass and spring constant) is also given by,



The velocity is given by,.

The magnitude of the maximum velocity is given by,    
  or 

The acceleration is given by,.  
   
 The magnitude of the maximum acceleration is given by,    
  or 

Procedure:

1) Connect the motion sensor to the Interface: yellow-1, black-2, and set the beam to narrow.

2) Attach 500-g mass (50-g mass hanger + 450-g) to the hard spring and hang it from the pendulum clamp. Record the total hanging mass.

3) Place the motion sensor directly under the hanging mass (use a plumb-line), on the lab table, and leave about 30-cm between the motion sensor and the hanging mass.

4. Setting up the Interface for data collection:  
a. Open **PASCO Capstone** software from the desktop.   
b. Click **Hardware Setup** under Tools on the left, click on the interface input where the sensor is connected and select **Motion Sensor II**. Click **Hardware Setup** again to close.   
c. Double-Click **Graph** under Displays on the right, click Select Measurement, and select **Position.**    
  
5)  Click Record, and after about 5 seconds, pull down the mass (about 5 cm) and release it, after collecting data for about 10 oscillations, stop the data collection.

6) The curve should resemble a cosine function. If not, delete the data and realign the motion sensor beneath the mass hanger, and try again.

7) Click on the Scale Axis button and maximize the graph.

DATA: Oscillating Mass = m = \_\_\_\_\_\_\_\_\_\_\_\_\_Spring Constant = k = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

I) From the Position VS. Time graph obtain the following:  
  
a. Equilibrium Position = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. Amplitude of the Oscillation = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c. Period of the Oscillation = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d. Calculate the period (using spring constant and oscillating mass) = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
  
  
II) Click Position, choose velocity, and from the Velocity VS. Time graph obtain the following:  
  
a. Maximum Velocity =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. Period of the Oscillation = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c. Calculate the period (using amplitude and maximum velocity) = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

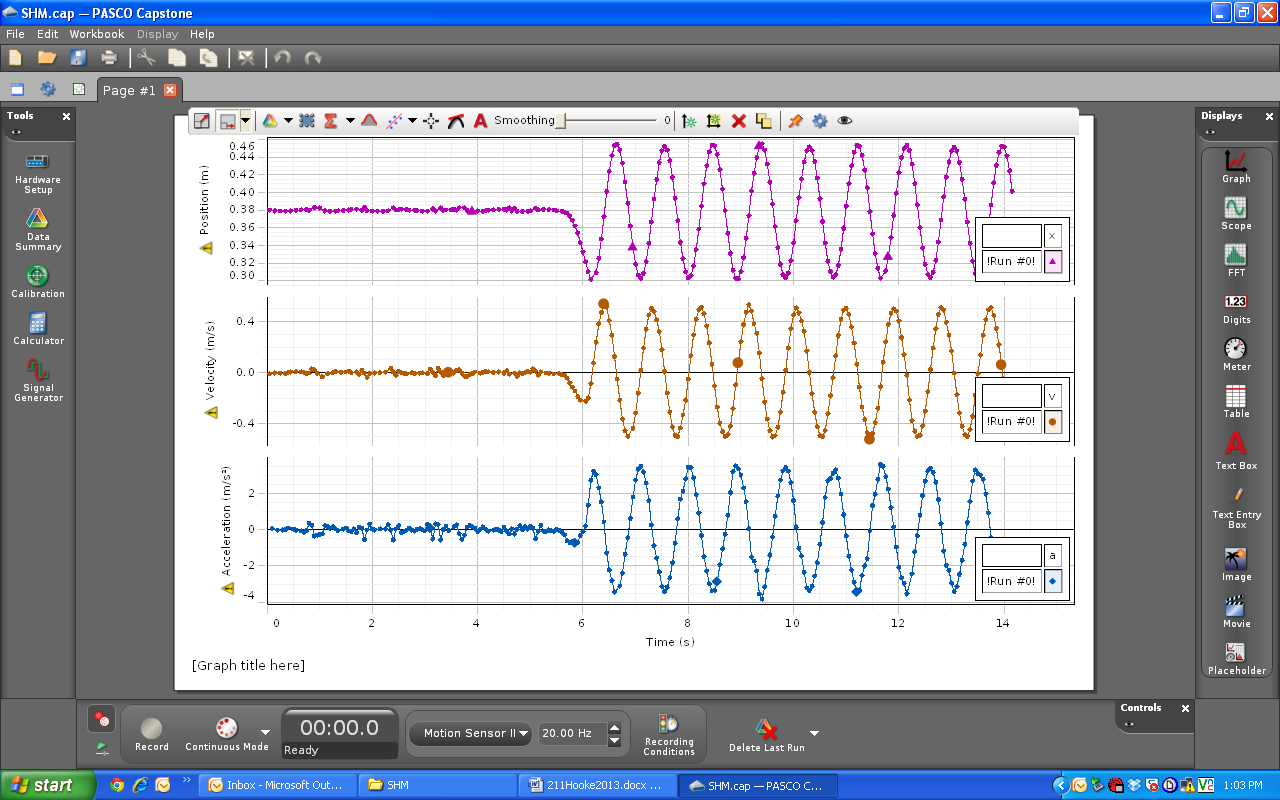
III) Click Velocity, choose acceleration, and from the Acceleration VS. Time graph obtain the following:  
  
a. Maximum Acceleration =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. Period of the Oscillation = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c. Calculate the Maximum force = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d. Calculate the period (using amplitude and maximum acceleration) = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

IV) To Display Position, Velocity, and Acceleration together:  
a. Click Acceleration, choose Position, and obtain the Position VS. Time graph, on the display.  
b. Click the “Add new plot area to the Graph Display” button (6th from right), click “Select Measuremnet”, and choose velocity.  
c. Click the “Add new plot area to the Graph Display” button (6th from right), click “Select Measurement”, and choose acceleration.   
d. Your display should looks like the following:



Answer the following questions (zero or maximum), using your display:

During the oscillation when the mass is at the equilibrium position, what is the,

1. Velocity \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_b. Acceleration \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

During the oscillation when the velocity of the mass is zero, what is the,

1. Amplitude \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_b. Acceleration \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

During the oscillation when the acceleration of the mass is zero, what is the,

1. Amplitude \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_b. Velocity \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_