In-Class Lab: Measurement

Name: Date:

Instructor: Section:

Data Sheet:

Part A - Measurements.

Record Data Here.

Rectangular Block - in units of (cm)

zero offset: meter stick precision:

L_1: L_2: L_3: L_{avg}:

W_1: W_2: W_3: W_{avg}:

H_1: H_2: H_3: H_{avg}:

Cylinder - in units of (mm)

zero offset: vernier precision: composition:

r: r: r: r_{avg}:

H_1: H_2: H_3: H_{avg}:

Steel Ball - in units of (mm)

zero offset: micrometer precision:

d_1: d_2: d_3: d_{avg}:

Data Table (1): Rectangular Block						
	(m)		**(cm)**		**(mm)**	
Length, L_{avg}						
Width, W_{avg}						
Height, H_{avg}						
Surface Area, A		(m^2)		(cm^2)		(mm^2)
Volume, V		(m^3)		(cm^3)		(mm^3)
Mass, M		(kg)		(g)		
Density, ρ_{block}		(kg/m^3)		(g/cm^3)		

Data Table (2): Cylinder						
	(m)		**(cm)**		**(mm)**	
Radius, r_{avg}						
Height, H_{avg}						
Surface Area, A		(m^2)		(cm^2)		(mm^2)
Volume, V		(m^3)		(cm^3)		(mm^3)
Mass, M		(kg)		(g)		
Density, $\rho_{cylinder}$		(kg/m^3)		(g/cm^3)		

Data Table (3): Steel Ball						
	(m)		**(cm)**		**(mm)**	
Diameter, d_{avg}						
Radius, $r = d_{avg}/2$						
Surface Area, A		(m^2)		(cm^2)		(mm^2)
Volume, V		(m^3)		(cm^3)		(mm^3)
Mass, M		(kg)		(g)		
Density, ρ_{ball}		(kg/m^3)		(g/cm^3)		

Data Table (4): Pendulum	
Time for 20 oscillations, t_{20}	
Period, T_{20}	
Period, T_c	
Period, T_0	

Week 1 - Analysis: Measurement

1. Using your measured density of the block, ρ_{block} and the accepted density of basswood, $\rho_o = 0.50$ g/cm^3 determine the *% error* of your measurement?
   SHOW *ALL* YOUR WORK.

2. Compare the results of your measured density of the cylinder, $\rho_{cylinder}$ with the accepted values of the densities given in the Table 1. Note that "compare" here means calculate the % error or % difference, whichever is more appropriate. **SHOW *ALL* YOUR WORK**.

3. Compare the results of your measured density of the steel ball, ρ_{ball} with the accepted density value of steel given in the Table 1. Note that "compare" here means calculate the % error or % difference, whichever is more appropriate.

Week 2 - Procedure and Analysis: Pendulum

1. Using a stopwatch, measure the total time t_{20} required to complete 20 (i.e., **full**) cycles of the clock pendulum, using the extreme left-side of the oscillation as your start/stop points. Remember that a complete cycle will involve the pendulum bob moving through the equilibrium position twice, once moving towards the right and once moving towards the left.
   Record your precision in Row 1, Column 2 of Table 4.

2. Calculate the period of the pendulum with, $T_{20} = t_{20}/20.0$ and don't forget to include units. Be sure to note the practical limitation of precision of the stopwatch and express t_{20} to the correct number of significant digits. **SHOW *ALL* YOUR WORK**.
   Record your value in Row 2, Column 2 of Table 4.

3. Now measure the period of the pendulum using the computer timing system, an infrared photogate. Your instructor will demonstrate this measurement and provide you with the resulting value designated with the parameter T_c.
   Record this measurement in Row 3, Column 2 of Table 4.

4. The theoretical value of the period of an ideal (i.e., **simple**) pendulum may be calculated as:

$$T_0 = 2\pi\sqrt{\frac{L}{g}}, \tag{1}$$

   where L is the length of pendulum support rod, in cm (in our case L = 82.1 cm) and g is the gravitational acceleration at the Earth's surface. For Johnson City, TN, this acceleration is 980 cm/s^2 = 9.80 m/s^2. Assume the clock pendulum behaves like an ideal pendulum and calculate its theoretical period T_0. **SHOW *ALL* YOUR WORK**.
   Record your value in Row 4, Column 2 of Table 4.

5. A pendulum whose characteristics are well known can be used to measure the gravity at different locations. Suppose that the pendulum we have been using (L = 82.1 cm) is taken to the surface of the Moon and its period is measured to be $T_M = 4.480$(s). Calculate the acceleration due to the Moons gravity from this data and compare it to the accepted value of $g_M = 162.2\ cm/s^2 = 1.622\ m/s^2$.

For Online Submissions

6. **Take a photo or scan a copy showing ALL calculations performed during this lab and upload it with this Lab Report in D2L.**