Name: ______________________________ BU ID: _______________ Lab Section: ______
Partner's name: ______________________ BU ID: ______________ Date: _____________
TF's signature: _______________________

PY105 Simple Harmonic Motion Experiment

Report Sheet

Fill in all the blanks and answer all the questions. Check with your TF to make sure that you have done everything before you leave.

Part1. Period of the pendulum with one mass attached (2.4 points)

m =________(kg) (0.2 pt) M_1=________(kg) (0.2 pt) M_2=_______(kg) (0.2 pt) (Refer to the lab. manual for the meaning of the variables.)

Mount mass 1 on the rod, and measure the period T by following the instructions given in the manual.

1 pt total

X_1(cm)	T(s)	T(8cm)[X_1 in cm/8]$^{1/2}$
8		
12		
16		

(0.4 pt) When X_1 increases, the period ….
[ ] increases [ ] decreases
(0.4 pt) Does the relation $T \propto (X_1)^{1/2}$ hold in your measurement? [ ] Yes [ ] No

Part II. Graphs for the angular position (θ), angular velocity (ω) and angular acceleration (α) of the pendulum as a function of time (3.6 points)

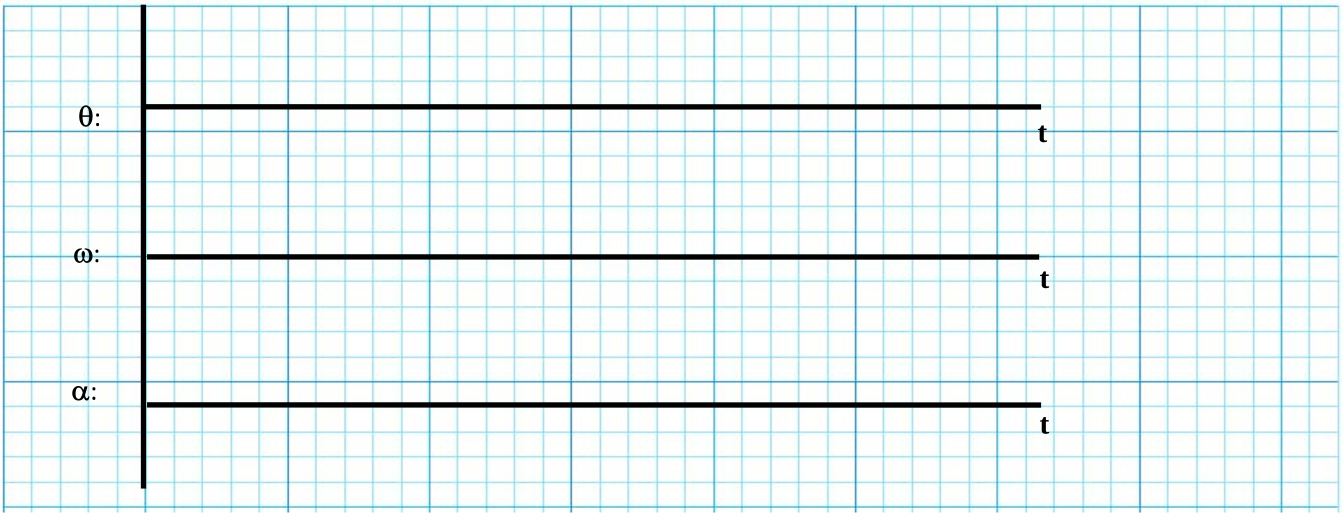
1. With the position of the bottom mass fixed, when you increase the distance of the bottom mass M_2 from the axis of rotation, the period of oscillation, T, increases / decreases (circle the correct answer; 0.2 pt). Explain your observation. (0.2 pt) (Hint: Consider the effect of the position of M_2 on both the torque acting on the pendulum and the moment of inertia of the pendulum.)

2. Position the bottom mass 16 cm from the center of the rod. Adjust the top mass's position (X_2) so that the pendulum period is 1.3 to 1.7 seconds. The position X_2 you find and the corresponding period of the pendulum is:

   X_2 = ________________ (m) (Assign an appropriate sign to X_2 as instructed on p.4 of the manual.) (0.1 point)

   Period = ________________ (s) (0.1 point)

3. Sketch the θ, ω and α versus time graphs you observe. (0.5 pt x 3) On each graph, <u>mark the range for one period of the curve.</u> (0.1 pt x 3) Make sure that your graphs have the SAME starting time. This will ensure that they have the correct relative phase.



For Questions 4-6 below, <u>circle the correct option(s):</u>

4. From the θ-t and ω-t graphs, ω is a maximum when θ is a minimum / zero / a maximum (0.2 pt); ω is zero when θ is a minimum / zero / a maximum. (0.2 pt)

5. From the θ-t and α-t graphs, when α is a maximum, θ is a minimum / zero / a maximum (0.2 pt); when α is a minimum, θ is a minimum / zero / a maximum. (0.2 pt) When α is zero, θ is a minimum / zero / a maximum. (0.2 pt)

6. When θ is positive, the sign of α is positive / negative (circle the correct answer; 0.2 pt).

Part III – Energy of the simple harmonic motion (use the "SHM-Energy program") (4.4 points)

L =________ (m); (0.1 pt) X_1=________(m);(0.1 pt) X_2 =________(m) (0.1 pt) (Assign appropriately positive and negative signs to X_1 and X_2 as instructed in the lab. manual)

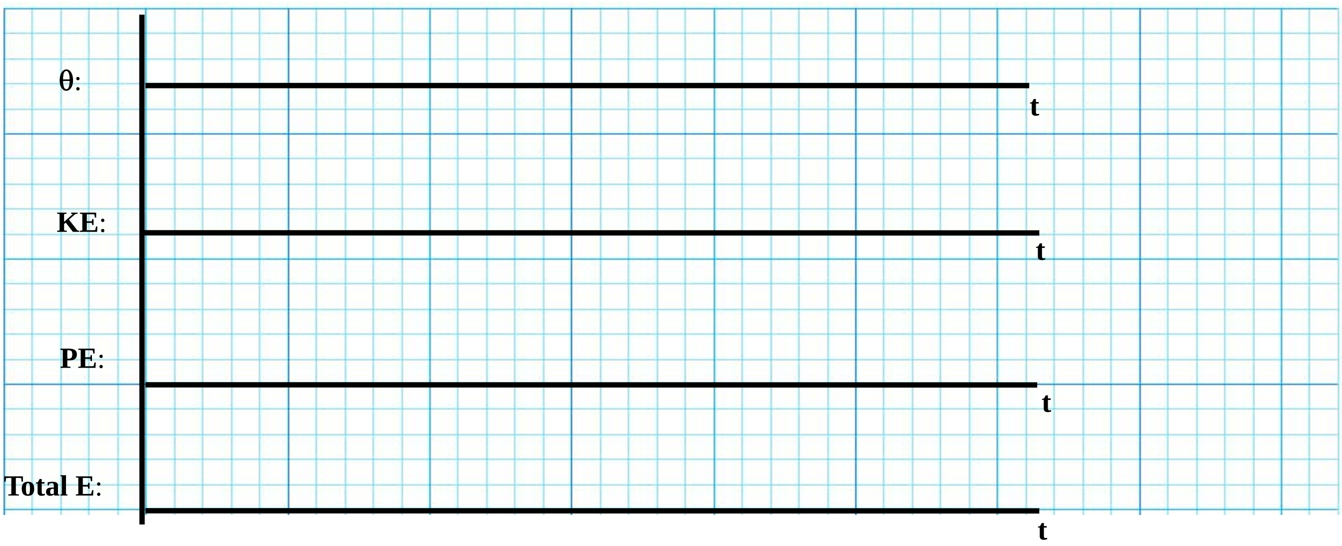
$I = mL^2/12 + M_1X_1^2 + M_2X_2^2$ =_______________ ($kg{\cdot}m^2$) (0.2 pt)

$M_{total} = m + M_1 + M_2$=____________(kg) (0.1 pt)

$X_{cm}= \dfrac{M_1X_1 + M_2X_2}{m + M_1 + M_2}$ =______________(m) (be careful with the sign of X_1 and X_2) (0.2 pt)

Sketch the angular displacement θ, kinetic energy (KE), potential energy (PE) and total energy (Total E) versus time graphs below (0.4 pt x 4). Ensure that your graphs have the SAME starting time.

On the θ and KE graphs, mark the range for one period of the curve. (0.1 pt × 2)



7. Do you find the total energy graph stay constant, increase, or decrease? (0.1 pt) How do you explain this observation? (0.1 pt)

8. Compare the KE-t graph to the θ-t graph. When the KE is a maximum, θ is a minimum / zero / a maximum (circle the correct answer(s); 0.2 pt.) Explain your observations.(0.2 pt)
   (Hint: Use the facts that $\theta \propto \cos(\Omega t)$ and $\omega \propto \sin(\Omega t)$ as given on p.1 of the lab. manual.)

9. How do the periods of the KE-t and θ-t graphs compare? (0.1 pt) Explain your observation.(0.2 pt)

10. Compare the PE-t graph to the θ-t graph. When the PE is a maximum, θ is a minimum / zero / a maximum (circle the correct answer(s); 0.2 pt.) How do you explain this observation? (Hint: Write the expression of PE in terms of θ. (0.1 pt) Recall that θ oscillates between $-\theta_{max}$ and $+\theta_{max}$, which have small magnitudes. (See equation (2) in the manual). Sketch a plot of $\cos\theta$ in the range $-\theta_{max} \leq \theta \leq +\theta_{max}$ (0.1 pt) and thereby explain the observation (0.1 pt).)

Pre-lab: ____________________________ (10 × 20% = 2 points)
Lab: ______________________________________ (10 × 80% = 8 points)

Punctuality (1 point) + performance (1point): ________________ (2 points)
Report sheet ______________________________ (10 points × 80% = 8 points)

Total: _________________________________
TF: ___________________________________ Grader: ________________________________