The Simple Pendulum Post Lab

Physics 203: Profs. Martens Yaverbaum, Bean, Lu, Walters
John Jay College of Criminal Justice, the CUNY

1. The Epistemological Table

Claim	Type of Knowledge
The x-axis in the component FBD of the pendulum bob was perpendicular to the string.	
The tension on the string is opposed by mgcos(**θ**).	
The tangential acceleration of the bob at any given moment is equal to gsin(**θ**).	
The acceleration in free fall is 9.8 m/s^2.	
The acceleration of the pendulum during the course of one swing is not constant.	
The average time for 20 full cycles of the pendulum on the fist trial was 24.3 s.	
The average time for a single period of the pendulum on the first trial was 1.22 s.	
The period of a pendulum is the amount of time it takes for the pendulum to swing back and forth.	
The period of a pendulum is dependent on the distance from the top of the pendulum to the center of the mass.	
Mass ***had*** no appreciable effect on the period of the pendulum ***in this experiment***.	
Mass ***should be expected to have*** no appreciable effect on the period of a pendulum ***in general***.	

2. The Research Design Chart

The first box in your research design chart should be ***the times you recorded for 20 swings of the pendulum with each of the different masses you tested***.

3. The Counter Factual

(a) Imagine you performed your experiment in an alternative universe and recorded the following data.

Mass (kg)	Length from the top of the Pendulum to the Center of Mass (cm)	Angle (degrees)	Average Period (s)
60 kg	30.2 cm	10^o	38.47 s
80 kg	30.2 cm	10^o	51.29 s
100 kg	30.2 cm	10^o	64.11 s
100 kg	35 cm	10^o	64.12 s
100 kg	40.3 cm	10^o	64.11 s
100 kg	40.3 cm	15^o	64.10 s
100 kg	40.3 cm	20^o	64.11 s

i. Which independent variable would you suspect the period of a pendulum to be dependent on?

ii. What type of mathematical function describes the relationship between that independent variable you chose and the period? Explain how you reached your conclusion. (A graph might help.)

(b) Oops, it turns out you were dreaming in part (a). The real results for the experiment looked more like the table below… or maybe you're ***still*** dreaming.

Mass (g)	Length from the top of the Pendulum to the Center of Mass (cm)	Angle (degrees)	Average Period (s)
60 g	15 cm	10^o	5.85×10^{-4} s
80 g	15 cm	10^o	5.86×10^{-4} s
100 g	15 cm	10^o	5.84×10^{-4} s
100 g	30 cm	10^o	2.38×10^{-3} s
100 g	45 cm	10^o	5.23×10^{-3} s
100 g	60 cm	10^o	9.29×10^{-3} s
100 g	75 cm	10^o	1.46×10^{-2} s
100 g	15 cm	15^o	5.81×10^{-4} s
100 g	15 cm	20^o	5.86×10^{-4} s

Answer the same two questions, i., and ii., from part (a). State and explain your new answers. You PROBABLY want to create a graph! Feel free to use computer software.

4. Wild Card

A pendulum bob is lifted to the left and released. It swings all the way to the right (counter-clockwise), then swings back (clockwise), completing one single period. Consider counter-clockwise to be the positive direction and clockwise to be the negative direction.

Answer each of the following questions regarding the swing described above and ***justify your answer*** for each one.

(a) When is the bob's acceleration highest in the negative direction?
(b) When is the bob's acceleration zero?
(c) When is the bob's acceleration highest in the positive direction?
(d) When is the bob's speed increasing?
(e) When is the bob's speed decreasing?
(f) When is the bob's speed zero?
(g) When is the bob's speed at its maximum?

Your ***justifications*** can and should involve: Newton's Laws, FBDs, basic definitions, observations, and common sense.

Think carefully each one. You will definitely want to refer back to the work you did in steps 6-11 of the lab. It may also help to make a pendulum out of a keychain or whatever you have handy and watch it closely.

You are ***strongly encouraged*** to use drawing(s) to help clarify your answers. Words can be confusing when answering questions like these.