*** <u>POST-LAB #2</u> ***

Post-Labs & Formal Reports:

A GENERAL EXPLANATION which contains within THE SPECIFIC QUESTIONS FOR Physics 204, LAB 2

PHYSICS 204: LAB
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I. *Epistemological Table*

(REMINDER OF…) BACKGROUND EXPLANATION (You can skip straight to this week's table if you're comfortable with the general expectations.)

If you make a ***claim***, someone might as you "How do you know?" and, if you consider yourself a scientist, you'd be obliged to ***justify*** your claim. From now on in this lab course, there are ***six*** basic ways that a claim can be justified.

(Note! A claim is a <u>full statement</u>; a claim is expressible as a complete sentence of English, and must therefore contain both a subject *and* a predicate. But note also: a mathematical equation is a sentence: the part before the equals sign is the subject; the rest is the predicate.)
Any claim that we make in a physics lab must have been:

- **Observed / Measured,**
- **Defined,**
- **Derived,**
- **Calculated,**
- **Postulated, or**
- **DISCOVERED through YOUR Research.**
  …
- And once in a while, we will make a claim that *seems* or maybe even is
  Not Justified
-

Each Physics Post-Lab will contain an EPISTEMOLOGICAL TABLE like the one shown below. Your job is to fill in the justifications, from the seven categories listed above. In some cases, you'll need to provide a little extra information.

1. OBSERVED/MEASURED (using). Measurement and observation are the two basic types of ***data collection***. Measurement is ***quantitative*** data collection: it produces something you would describe with ***numbers***. Observation is qualitative data collection: it produces something that you would describe with ***words***.

When using this category in the Epistemological Table, you should specify either "Observed (qualitative data collection)" or "Measured (quantitative data collection)." In addition, if a claim is the result of measurement, you must specify the measurement device: "Measured using protractor (quantitative data collection)" or "Measured using stopwatch (quantitative data collection)."

2. DEFINED (definition of). This category includes anything that is defined either by the researchers themselves in the course of the lab or by physicists in the past. A definition is ***not*** a discovery. If you define the top of the window to be x=0 or you define average velocity to be displacement over time, you're not figuring anything out about the world; you're simply ***naming*** things. When using this category you must state what is being defined: e.g. "Definition of Mass" or "Definition of Distance." Etc.

3. CALCULATED (from): any ***numerical value*** that is calculated, through ***mathematical operations*** on other (measured or assumed) quantities. When using this category you must state what equation(s) were used to calculate the value: e.g. "Calculated from the definition of average velocity" or "Calculated from Netwon's Second Law."

4. DERIVED (from). Derived knowledge is anything (equation or verbal statement) that is derived (i.e. figured out) through ***logic and/or mathematical proof***. When using this category, you must specify which laws, definitions, observations, etc. you used to derived this statement: "Derived from the definition of acceleration and the midpoint velocity formula" or "derived from Newton's first law."

5. POSTULATED. Postulates are statements that form ***the basic assumptions of an area of study (in this case, physics)***. A postulate is not directly provable, but it is accepted because it makes all the rest of physics possible. Only a VERY small number of claims fall into this category. When using this category, state the name of the postulate: e.g. "Postulated: Galileo's Principle of Relativity" or "Postulated: Newton's Second Law."

6. DISCOVERED THROUGH OUR RESEARCH. This category is reserved for things that you learned not by ***pure*** observation, measurement, derivation, calculation, or postulation, but through ***the strategic combination of these various forms of knowledge***, which we call ***scientific research***. This could be something that you discovered in a previous lab in this course or something that you discovered in this lab, after doing a bunch of data collection AND analysis. If a claim was proved in a previous lab, you should specify which lab: e.g. "Discovered through our research, in the 'Free Fall' experiment."

7.NOT JUSTIFIED. You should use this category VERY rarely. It is reserved for statements that you are taking as true basically just because someone told you they were true and you believed them—i.e. statements that you have no way to verify.

WHAT TO DO FOR THIS PARTICULAR (Lab #2) POST-LAB:

Reproduce this table in a SEPARATE document or sheet of paper and choose among the ***seven*** categories listed above in order to complete it.

NOTE: the Justification **MUST INCLUDE** some sort of prepositional phrase that narrows the type (and makes it easier for instructors to award credit for valid justifications they did not anticipate), e.g.: "derived ***from…***," "measured ***with*** (using)…" "definition ***of…***," etc.

Claim	Type of Justification
a) A mass suspended from a long vertical string started to swing back and forth if released from anywhere other than the lowest possible position.	
b) Released at an angle of 10.0 degrees from the vertical, a mass on a 9.80 cm string took approximately 12.2 seconds to complete 20.0 cycles.	
c) The amount of time taken for this mass to complete one cycle was approximately .610 seconds.	
d) The amount of time taken to complete one cycle is referred to as the pendulum's '***period***'.	
e) Released at angles of 5.00, 12.0, 15.0 and 18.0 degrees from the vertical, a mass on a 9.80 cm string continued to take approximately 12.1 seconds to complete 20 cycles.	
f) If the pendulum described in parts (a) through (c), above were released at 7 degrees from the vertical, it should take approximately 12.2 seconds to complete 20 cycles.	
g) The period of a simple pendulum varies if the length of the pendulum string is varied.	
h) The period of a simple pendulum varies in direct proportion to the square root of the string length.	
i) The angular position of the pendulum at any point in time can be described by a function which satisfies $\frac{d^2\theta}{dt^2} = -(\omega^2)\theta$.	

II. *Research Design Chart.*

BACKGROUND EXPLANATION.

The chart begins with your ***Research Question*** and shows how you proceeded from data collection FOR at least ONE MEASUREMENT all the way toward an answer for that ***Research Question*** (***RQ***).

Note: For this and all future ***Post-Labs***, you need only select ONE particular ***RQ*** and one particular data thread for depiction in a ***Chart***.

Always write your ***RQ*** right above your ***Research Design Chart***

The chart has 3 sections:

DATA COLLECTION: Measurement(s) you took or observation(s) you made in the lab.	→	ANALYSIS: Some mathematical or logical analysis you did on those measured quantities or observations.	→	CONCLUSION: How that analysis helped you answer your Research Question

<u>Example</u>

RQ: how does changing the volume of a chamber affect the temperature of a the gas inside the chamber?

We measured the initial length, width & height of the chamber and got 7 cm, 5 cm, and 8cm, respectively.	→	We substituted these values into the equation for the volume of a rectangular prism: $V=W\times L\times H$. We concluded that the initial volume of the chamber was $5cm \times 7cm \times 8cm = 280 cm^3$	→	Knowing the initial volume of the chamber allowed us to compare that to the volume after the chamber was compressed, which allowed us to see the change in volume, which helped us determine the relationship between change in volume to change in pressure.

<u>WHAT TO DO FOR THIS PARTICULAR (Lab #2) POST-LAB</u>:

Using the model provided by two figures above, make a ***Research Design Chart*** that applies specifically to at least ONE MEASUREMENT you made in Lab #2.

III. ***The Counter-Factual***.

BACKGROUND EXPLANATION.

At this point in the semester, we let this portion of the ***Post-Lab*** speak for itself. It is simply a question or small set of questions that asks you to consider the implications of something that most probably did NOT happen in your laboratory experience. Though it might seem as though we are asking you to waste thought or time on a non-sequitur (to something entirely unrelated to the issues at hand), we are not. In fact, we are asking you to identify, scrutinize, test or possibly challenge some kind of reasoning that is central to the lab—and therefore to the ***Formal*** Lab ***Report***.

<u>WHAT TO DO FOR THIS PARTICULAR (Lab #2) POST-LAB</u>:

In complete sentences of English, answer the following two questions (two parts each, second question is on the next page):

a. Imagine that in the hypothetical counter-factual world, you did and thought about everything in this experiment precisely as you did in your actual John Jay experience, EXCEPT one thing: all the initial angles you measured and tried (as initial release-positions for your pendulum) were pretty large—they ranged from 40 degrees to 70 degrees as measured from the vertical. It is too late to go back to the lab, so you go ahead and draft a full formal report anyway.

    i. in what specific ways (if any) would this accidental choice of angles change your final answer to a Research Question concerning the variable(s) on which pendulum period depends? That is, would you suppose differing large angles to produce differing periods? If not, why not? If so, in which direction (larger angles → larger ***or*** smaller periods)?

    ii. in what specific ways (if any) would this would this accidental choice of angles change your final answer to a Research Question concerning the type of oscillation characteristic of a planar pendulum? That is, would you suppose a large-angle planar pendulum to demonstrate simple ***harmonic*** oscillation? Why or why not?

b. In the hypothetical counter-factual world where you used small angles and followed all suggested procedures precisely to the letter, your lab partner says, "Thank goodness we're finally dealing with something traveling in a curve. Now 'angular frequency' makes sense. Since the pendulum mass is also swinging through angles that are measured from the vertical, the radians per second indicated by omega now simply refer to how fast the pendulum is traveling. When it's close to equilibrium, it's zooming through angles at close to its maximum speed, so its omega is very large; up near the turning points, the omega is practically zero."

    In at least two complete sentences of your own words, how would you respond to your partner? Do you think she's saying something correct but unhelpful? Correct and helpful? Incorrect yet helpful? Etc.

IV. *The Wild Card.*

BACKGROUND EXPLANATION.

There is no 'Background Explanation' for something called a ***Wild Card***. We claim that you know that. Our justification is "by definition of ***Wild Card***". In other words, each week the ***Wild Card*** is one final piece of written reflection for which you are responsible – but which can appear in any form — whether familiar or unfamiliar.

The ***Wild Card*** might require another simple diagram or another 'counter-factual' paragraph of writing (things already done) or it might ask you to communicate your understanding in a manner you have not previously considered – such as "knit a sock puppet who can perform a one-act pantomime play about the particle's acceleration". The reason for a ***Wild Card*** is that each particular experiment raises its own particular issues and concerns. Often, particular issues are best expressed by means of their own particular modes of expression. (Usually, there are more effective and precise ways to convey physics findings than by means of a sock puppet.)

<u>WHAT TO DO FOR THIS PARTICULAR (Lab #2) POST-LAB:</u>

In at least ***two*** clear and careful pictures for <u>each</u> and in at least ***three*** complete sentences of your own words for ***each***, please respond to the following:

A) Why does the period of a simple planar pendulum seem to be independent of the mass at the end of the pendulum string?

B) If a simple planar pendulum seems to be a simple harmonic oscillator, and if a simple harmonic oscillator is a system that acts like a mass on a spring, then why is the period of a mass on a spring independent of spring ***length***?

C) Describe an entirely different scenario in which
the time-rate of change of some variable is a function of that variable itself.
Ideally, you might come up with a situation in which it is the rate of change of the rate of change (i.e.: the second derivative) that is relevant and in which the function at hand is a linear function, but neither of these two features is mandatory. Somehow or another in words and pictures, capture a situation in which some quantity changes as time passes – in a manner that is directly determined by that quantity itself (as opposed to being directly determined by time).

You can draw this situation from your imagination, from familiar scientific phenomena or from daily life – from anywhere as long as the scenario is clearly described and convincingly fits with the required relationship.