~ Free Fall: Post Lab ~

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1. Epistemological Table

Claim	Type of Knowledge
If a vertically-oriented string with machine screws attached is dropped, all of the machine screws will begin moving at essentially the same time.	
If two machine screws, A and B, are dropped, and it is found that A takes less time to cover a given distance than B, then A's average speed while covering the given distance is greater than B's average speed while covering that distance.	
When a machine screw falls from a ceiling of 5 meters to a floor at 0 meters, it passes through every possible height between 0 and 5 meters; put another way, any number you could ever possible think of between 0 and 5 (such as 2.087112087112...) represents a height at which a screw that fell from 5 meters must spend at least one instant.	
When metal machine screws "free fall" towards the earth's surface from heights less than or equal to 5 m, any possible influences from air resistance are too small to be noticeable.	
A string with evenly-spaced machine screws produces a rhythm of ***decreasing*** times between beats when dropped from a height of 5 meters onto a cookie sheet.	
The above claim implies that the machine screws speed up as they fall.	
Average velocity is equal to change in position divided by time elapsed.	
In "Pattern B," the ***differences between the differences between the distances*** between screws remained constant.	

2. Research Design Chart.

In this lab, you may have an RQ about how to produce an even rhythm. That's fine, but you must also have an RQ about how objects move in free-fall (constant v, constant a, etc.). It is ***this RQ about the nature of free-fall***, not the other one, that should go ***above your RDC***.

Also, your observation for box #1 should be: ***whatever you observed about the rhythm of the screws when you dropped the string with evenly spaced screws***. and relate this to your answer to the RQ about how objects move in free-fall.

3. The Counter Factual

NOTE: in the counter-factual problems, we will sometimes provide you with scenarios in which there is data that is ***not in line with reality***. As in this week's problems, we may then ask you to ***draw conclusions from these data***. As good scientists, your job is to draw conclusions ***from the data***, not from what you assume to be the case. If it makes things clearer, imagine that these kinds of questions are taking place in an ***alternate reality***.

ALSO NOTE: sometimes you have to think ***hard*** & do ***a bunch of work*** to answer the counter-factual. ***Don't cut corners!***

A. Imagine that your lab group (which may or may not be taking physics in an alternate reality) creates a string with screws at ***positions*** 1m, 2m, 3m, 4m, and 5m. You drop this string from a height of 5m, just as the lab instructions tell you to do, and you notice that the time intervals between screws hitting the cookie sheet get ***larger*** with each screw. The first two impacts are close together, then a little farther apart, then farther, and farther. Assume that all your measurements and observations are more or less accurate and that you performed your drop correctly. What would you conclude from your data about the behavior of objects in free fall?

B. Now imagine that you are living in a world where free-falling objects have an ***upwards*** jerk (i.e. a negative jerk if down is positive). In other words, they ***accelerate*** downwards, but the downwards acceleration gets smaller and smaller with each beat.

i. Design a pattern of bolt positions that might produce a steady rhythm in this imaginary world. Think hard. This is ***hard***.

BIG Hint: to do this, you will have to pick some arbitrary, ***large*** downwards acceleration to start out with, and some ***small*** constant upwards jerk (amount the acceleration shrinks by for each beat). But remember: jerk is a change in acceleration, ***not*** a change in velocity!

Show ALL work relating to your pattern.

ii. Draw both a position and a displacement diagram for your pattern.

iii. Using math, words, & diagrams (as necessary), explain why your pattern should produce a steady rhythm in the imaginary world where free-fall acceleration is downward but jerk is upward: ***i.e. justify your solution***.

4. Wild Card

Assume that you were able to create a string that produced a constant rhythm when dropped onto the cookie sheet. Imagine you dropped that string on the surface of the moon, where gravity is about 1/6 as strong as it is here on earth, would the string still produce an even rhythm? How would the rhythm produced by the string on the moon be similar or different to the one it produced on earth? Explain your reasoning.