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Professor Kemper

Phys 121L Sec. 4

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- **Sample Calculations**

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1) $T_{Period} = \frac{t_{avg}}{N}$

2) Period of one oscillation equals the average time of 3 trials, divided by oscillations per trial.

3) $T_{period} = \frac{6.96 \text{ Seconds}}{10}$ units

4) $T_{period} = .696$ Seconds

· In class equation:

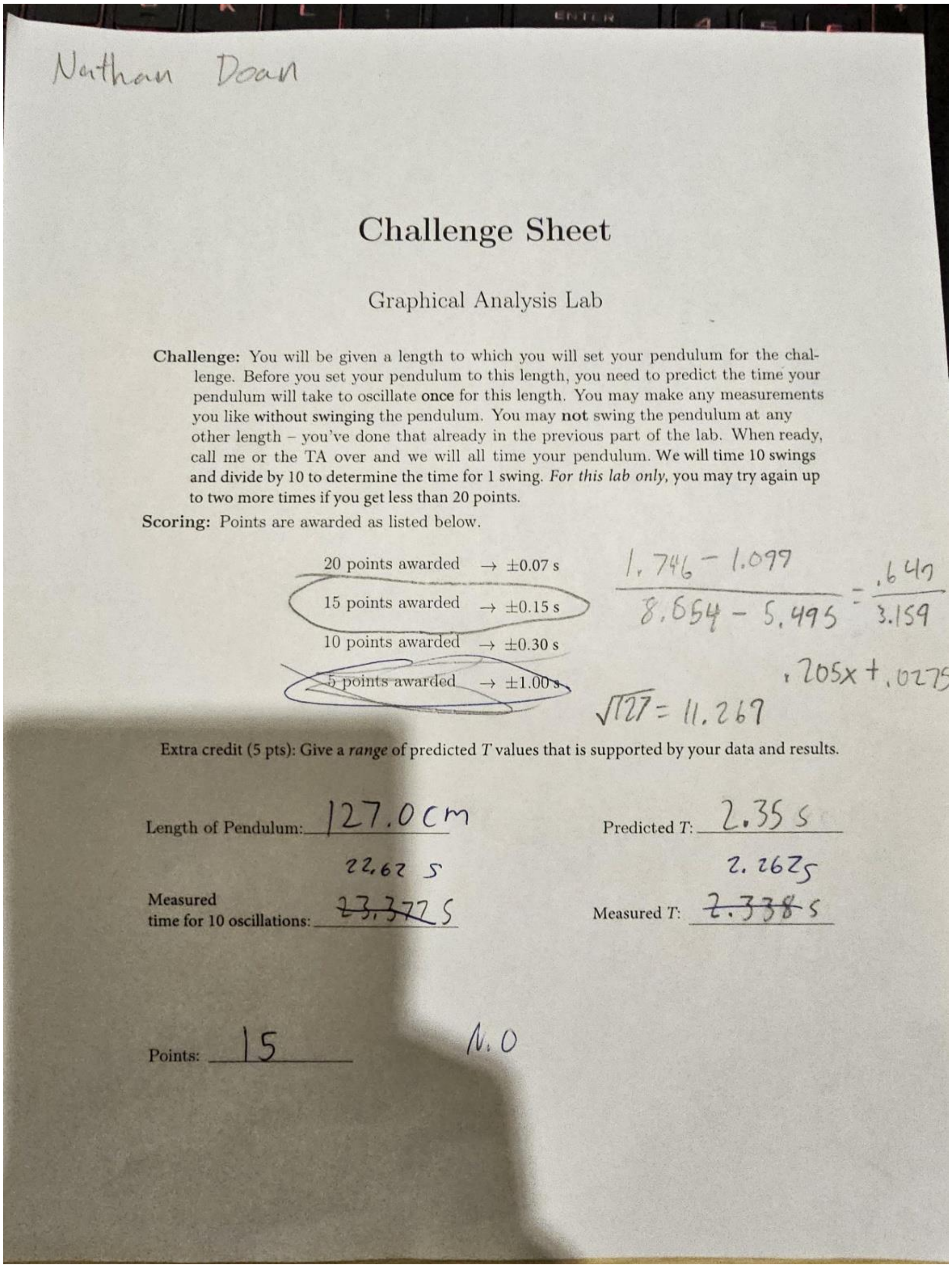
1) $T_{Period} = .2006 \frac{s}{cm^{1/2}} \ell^{1/2}$, 3rd 2nd $\cancel{T = .1976x + .02749}$, $\cancel{\ln P = .478x - 1.516}$

2) Period of one oscillation equals the length of String to the power of (1/2) multiplied by .2006

3) $T_{period} = .2006 \frac{s}{cm^{1/2}} (8.76)^{1/2} s$

4) $T_{period} = .594 s$

- Challenge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Challenge Sheet

Graphical Analysis Lab

Challenge: You will be given a length to which you will set your pendulum for the challenge. Before you set your pendulum to this length, you need to predict the time your pendulum will take to oscillate **once** for this length. You may make any measurements you like **without swinging** the pendulum. You may **not** swing the pendulum at any other length – you've done that already in the previous part of the lab. When ready, call me or the TA over and we will all time your pendulum. We will time 10 swings and divide by 10 to determine the time for 1 swing. *For this lab only,* you may try again up to two more times if you get less than 20 points.

Scoring: Points are awarded as listed below.

20 points awarded → ±0.07 s

15 points awarded → ±0.15 s

10 points awarded → ±0.30 s

~~5 points awarded~~ → ±1.00 s

$\frac{1.746 - 1.099}{8.654 - 5.495} = \frac{.647}{3.159}$

$.205x + .0275$

$\sqrt{127} = 11.269$

Extra credit (5 pts): Give a *range* of predicted T values that is supported by your data and results.

Length of Pendulum: 127.0 cm

Predicted T: 2.35 s

Measured time for 10 oscillations: ~~23.377~~ s 22.62 s

Measured T: ~~2.338~~ s 2.262 s

Points: 15

N.O

Summary: Our calculations to find the time per oscillation incorporated our equation from our 3rd graph. To find that equation, we chose two points and estimated the slope, using the slope formula (y2-y1/x2-x1), yielding: y=.205x+.0275. Square rooting the length (127cm) then plugging it in for x gives us 2.35s per oscillation.

- **Discussion Questions**

1. Why do we try to make linear plots in this lab? What can we do with data sets that have a linear relationship that we cannot do with data that are not linearly related?

- The use linear regression on graphs allows us to predict measurements of a hypothetical lab.

2. If you had two sets of unitless x-y data, where data set 1 follows y = x^3 and 2 follows y = x^(1/3) - 12, what methods could you use to plot each of the data sets to guarantee that both plots as straight lines?

- I would plug in numbers (1,2,3,4,5) for each equation then place those into a data sheet, then I would perform the =LINEST function on excel, then graph.

3. How will your final equation, relating the pendulum length to its period, change if you repeat the lab but measure the string length instead of the pendulum length (i.e. to the center of the bob) each time? This is an example of a systematic error.

- If we had measured the length of the whole string than the center of the bob, our measurements would show that each oscillation measured would have a larger time than the predicted data. This would change our equation by having our ".2006" being increased for the systematic error equation.