

Name: \_\_\_\_\_

Student ID# \_\_\_\_\_

Date: \_\_\_\_\_ Time: \_\_\_\_\_

Lab Instructor: \_\_\_\_\_

## Physics 104 Lab Exam - SAMPLE

**Instructions:** *Work individually to complete each exercise to the best of your ability, show all your work, and clearly explain your answers in the spaces provided or on the back of these papers. Be sure to record all measurements (in SI units) and show all calculations. For items that require a numerical result, write your answer as you would for a formal lab report, including a meaningful **label** to identify a value. Your answer will be graded based on the **accuracy** of your result and proper reporting of **uncertainty**, **significant figures**, and **units**. Once the lab exam begins, you are not permitted to receive any assistance from your TA or other students. However, you may use your lab manual, graded lab reports, notes, and textbook as resources for this exam. The questions may be answered in any order, so adjust your work according to the availability of the lab equipment, and **do not spend more than 20 minutes at any one lab exam station** so that every student has an equal opportunity to complete the exercises.*

**Honor Pledge:** *All work presented here is my own.* \_\_\_\_\_

1. A simple pendulum is known to have a period of oscillation  $T = 1.55$  s. Student A uses a digital stopwatch to measure the total time for 5 oscillations and calculates an average period  $T = 1.25$  s. Student B uses an analog wristwatch and the same procedure to calculate an average period for the 5 oscillations and finds  $T = 1.6$  s.

a) Which student made the more accurate measurement? Explain.

b) Which measurement is more precise? Explain.

c) What is the most likely source of error that could account for the difference in the results?

2. The number of significant figures reported for a measured value suggests a certain degree of precision. What is the relative uncertainty implied by the following numbers?

a) 0.30 implies an uncertainty of  $\pm$  \_\_\_\_\_ %

b) 9.8 implies an uncertainty of  $\pm$  \_\_\_\_\_ %

c) 52 implies an uncertainty of  $\pm$  \_\_\_\_\_ %

d) 0.503 implies an uncertainty of  $\pm$  \_\_\_\_\_ %

3. A student uses a protractor to measure an angle to be  $\theta = 85^\circ \pm 1^\circ$ . What should she report for  $\sin \theta$ ?

4. Use any available equipment to find the radius of a tennis ball as accurately as possible. Explain the procedure you used.

$R =$  \_\_\_\_\_

5. Use any available equipment to measure the acceleration of a glider on an inclined air track as accurately as possible. Clearly identify the measurements you make and the procedure you use.

6. Use a Vernier caliper and a mass balance to find the density of a nickel coin. Is this measured density value consistent with the density of pure nickel? ( $\rho_{\text{nickel}} = 8.912 \text{ g/cm}^3$ ). From your measured density, can you determine whether nickel coins are made of pure nickel? Which of your measurements contributes the most uncertainty to your measured density value? (Equipment provided: 10 nickel coins, Vernier caliper, balance with 0.1 g resolution)

7. A group of students are told to use a meter stick to find the length of a hallway. They take 6 independent measurements as follows: 3.314 m, 3.225 m, 3.332 m, 3.875 m, 3.374 m, 3.285 m. Show how they should report their findings and explain your answer.

8. In an investigation to empirically determine the value of  $\pi$ , a student measures the circumference and diameter of several circles of varying size and uses Excel to make a linear plot of circumference versus diameter (both in units of meters). A linear regression fit yields the result of:  $y = 3.1527x - 0.0502$ , with  $R^2 = 0.9967$  for the 5 data points plotted. How should this student report the final result? Does the empirical ratio of C/D agree with the accepted value of  $\pi$ ?

9. A student performs a simple experiment to find the average acceleration of a falling object. He drops a baseball from a building and uses a string and meter stick to measure the height the ball was dropped. He uses a stopwatch to find an average time of fall for 3 trials from the same height and reports the following data:  $h = 5.25 \pm 0.15 \text{ m}$ ,  $t = 1.14 \pm 0.06 \text{ s}$ .

a) Use the equation  $a = 2h/t^2$  to determine the average acceleration and its uncertainty.

b) Comment on the accuracy of the acceleration result. Do you think the student made any mistakes?

c) What one suggestion would you tell this student to improve the experimental result? Please explain.

10. Describe a procedure you could use to determine the coefficient of friction between two objects.