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## **AUTHENTIC ASSESSMENT** Presenter: Andrew Jackson, Harrisonburg High School ajackson@harrisonburg.k12.va.us

### **Va. SOL:**

- PH.1 The student will plan and conduct investigations in which
- PH.2 The student will investigate and understand how to analyze and interpret data. Key concepts include
- a) a description of a physical problem is translated into a mathematical statement in order to find a solution;
  - b) relationships between physical quantities are determined using the shape of a curve passing through experimentally obtained data;
  - c) the slope of a linear relationship is calculated and includes appropriate units;
  - d) interpolated, extrapolated, and analyzed trends are used to make predictions; and
  - e) analysis of systems employs vector quantities utilizing trigonometric and graphical methods.

### **National Standards:**

**DESIGN AND CONDUCT SCIENTIFIC INVESTIGATIONS.** Designing and conducting a scientific investigation requires introduction to the major concepts in the area being investigated, proper equipment, safety precautions, assistance with methodological problems, recommendations for use of technologies, clarification of ideas that guide the inquiry, and scientific knowledge obtained from sources other than the actual investigation. The investigation may also require student clarification of the question, method, controls, and variables; student organization and display of data; student revision of methods and explanations; and a public presentation of the results with a critical response from peers. Regardless of the scientific investigation performed, students must use evidence, apply logic, and construct an argument for their proposed explanations.

### **Topic/Concept**

Three different “lab based” portions of exams I have used. These are my attempt to measure the student’s ability to collect and analyze data.

### **Materials**

- |                       |            |                      |
|-----------------------|------------|----------------------|
| • ring stand          | ring stand | resistance coils set |
| • clamp and cross bar | cross bar  | multimeter           |
| • spring              | string     |                      |
| • mass set            | mass set   |                      |
| • ruler               | ruler      |                      |
|                       | stopwatch  |                      |

### **Safety Considerations**

None.

## How the physics is demonstrated

### Lab Analysis Portion of Exam

“How does the stretch of a spring depend on the force applied to it?”

- Data collection

- Presented in a clear and correct manner. Includes units, labels, table form
- Multiple trials completed and recorded.
- 5 or more data points collected across a wide range of force
- precision of measurements presented, consistent & reasonable

- In this experiment, what was the dependent variable \_\_\_\_\_  
Independent variable \_\_\_\_\_. Explain why this is so.

- Use Graphical Analysis to construct a graph of Force Vs. Stretch. Go against convention and plot the force on the Y-axis. Fit a best fit line or curve to the data.

- Write the equation for this line or curve using symbols appropriate to the experiment.

- Determine the units for any and all constants in the equation. Show work or explain how you arrived at these units.

- Explain the meaning of any and all constants.

- Would it be reasonable to assume a different value for any of these constants other than what the computer says? Why or why not?

- Use words and numbers to answer the question “How does the stretch of a spring depend on the force applied to it?” What would be the same and what would be different if you conducted the experiment with a spring that was “looser” or more easily stretched?



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## EXAM - Lab Analysis

### The Analysis

Question 1 - How does the period of a pendulum depend on the mass of the pendulum bob?

Question 2 - How does the period of a pendulum depend on the arc of swing?

Question 3 - How does the period of a pendulum depend on the length of the pendulum?

### The Method

A. Create a graph that corresponds to each of the three questions. Make your name part of the title so there will be no confusion at the printer.

B. On the back of each graph, answer the corresponding question above as completely as your data allows. If your data does not agree with what you read in a text, explain what your data shows first, then tell how this differs from what you read. Make sure you refer to the graph and explain how it supports the conclusions you make. If for some reason you did not collect the right data, or right amount of data, to complete part A & B, explain (for partial credit) what you should have done.

C. For the graph for question #3, determine the mathematical relationship that exists between the two variables. Write the equation using correct symbols for length and time and with correct units for any numbers in the equation that should have units.

D. From your equation for #3, calculate what length of pendulum will have a period of 1.00 s. Obviously this is a very useful length for a pendulum for keeping time. Show your work.

**PURPOSE-** Does the student know how to apply the scientific method to a new situation? Can the student collect and correctly interpret data? Can the student create and use graphical representations of that data?

**MATERIALS-** Multimeter, coils of #30 Nickel-Silver wire of various known lengths from 40 cm to 200 cm, a 200 cm coil of #28 Nickel-Silver wire, and a 2000 cm coil of #30 copper wire.

**PROCEDURE-** Design and conduct an experiment to determine the answers to the following questions.

A. Based only on your data, how are the length of a metallic conductor and its resistance related? provide a table and a graph that support your answer.

bubble in #61-#68 with your answer to this question

- A. They are directly proportional.
- B. They are inversely proportional.
- C. Resistance is directly proportional to the square of the length
- D. Resistance is inversely proportional to the square of the length
- E. Resistance does not depend on the length of the conductor.

B. # 28 wire is of larger cross sectional area than #30 wire. Based only on your data, how are the diameter of a conductor and its resistance related?

bubble in #69-#76 with your answer to this question

A. As the diameter increases the resistance increases but there is not enough information to determine if they are directly proportional because there are only two data points.

B. The resistance is directly proportional to the diameter since if you graph the data you get a straight line.

C. Resistance doesn't seem to depend on the diameter of the wire.

D. The resistance decreases as the diameter increases but there is not enough information available to determine if they are inversely proportional or if there is an exponential relationship like inversely proportional to the square of the diameter.

C. Which is the better conductor, Copper or Ni-Sil? Explain and defend your answer.



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D. For equal lengths and diameters how many times better a conductor is one material than the other? (Show all your work)

E. Resistivity is a property of a material. Resistivity is given by the following equation

$$\rho = \frac{R A}{L}$$

Where R is resistance, A is cross sectional area, and L is length. . Copper in any shape or size has a resistivity of  $1.7 \times 10^{-8} \Omega\text{m}$ . Using this information and your measurements, determine the diameter of #30 and #28 wire.

### **Construction and Tips Regarding the Demonstration**

These are not labs my students have done before the exam. The purpose is to assess their ability to collect and analyze data in a new situation. None of these require any great construction or set up. Some students do require a considerable amount of time to collect and analyze the data. One way is to have students collect the data the day before the exam and then give the analysis questions on the exam.

### **Sources & References**

None