Midterm Exam Grading Sheet
Academic & Honors Physics

Name _____ **Period** _____

_____ **Prelab (10 points):** _____ / 10 questions completed

_____ **Hypothesis (10 points):**
- _____ makes an educated guess as to the result(s) (explains reasoning)
- _____ clearly addresses the purpose statement

_____ **Procedure/Data (20 points):**
- _____ uses good scientific method
- _____ records observations and ALL measurements made (including constants) in organized, labeled tables
- _____ all numbers have units and correct significant figures
- _____ includes at least 6 data points per graph

_____ **Data Analysis (30 points):**
- _____ graphs with proper graphing techniques (title, labeled axes, units, independent variable on x-axis, appropriate scales, best fit curve, etc)
- _____ includes regression statistics and COR values for graphs, and (when appropriate) several different graphs to determine the best fit curve
- _____ includes correct mathematical models of the graph w/ the curve best fitting the data (derivation of equation, units on slope and y intercept, variables are more descriptive than x and y)

_____ **Conclusion (30 points):**
- _____ relates to the purpose and is accurate as possible based upon the data available, addresses the accuracy of the hypothesis
- _____ states the relationship identified in a clear, concise English sentence.
- _____ includes the mathematical models (equations) which most accurately represents your data, discussing the physical meaning of the slope and y-intercept (don't forget the 5% rule) (even if there is no mathematical relationship, the conclusion must still be backed up with info from the data and data analysis sections)

_____ **FINAL GRADE**

Students will make hypotheses about the relationships between voltage, current, and resistence in an electric circuit, and design and carry out experiments and analyze data to test these hypotheses.

B.1. Students methodically plan, conduct, analyze data from, and communicate results of in-depth scientific investigations, including experiments guided by a testable hypothesis.

a. Identify questions, concepts, and testable hypotheses that guide scientific investigations.

b. Design and safely conduct methodical scientific investigations, including experiments with controls.

c. Use statistics to summarize, describe, analyze, and interpret results.

Evidence Level>>> Scoring Criteria	**1** Does Not Meet Standard	**2** Partially Meets Standard	**3** Meets Standard	**4** Exceeds Standard
B.1. Students methodically plan, conduct, analyze data from, and communicate results of in-depth scientific investigations, including experiments guided by a testable hypothesis.	**hypothesis:** • does not address the purpose statement **procedure/data:** • poor scientific method (no control variable) **data analysis:** • one or more graphs missing **conclusion:** • does not relates to the purpose	**hypothesis:** • partially addresses the purpose statement **procedure/data:** • uses good scientific method for at least one of the two experiments • data is included **data analysis:** • at least one graph present for both experiments **conclusion:** • relates to the purpose	**hypothesis:** • clearly addresses the purpose statement **procedure/data:** • uses good scientific method • records observations and ALL measurements made in organized, labeled tables **data analysis:** • graphs with proper graphing techniques (title, labeled axes, units, independent variable on x-axis, appropriate scales, best fit curve, etc) • includes (when appropriate) several different graphs to determine the best fit curve **conclusion:** • relates to the purpose and is accurate as possible based upon the data available • states the relationship identified in a clear, concise English sentence.	**all in "meets the standard"** **PLUS:** **hypothesis:** • makes an educated guess as to the result(s) (explains reasoning) **procedure/data:** • all numbers have units and correct significant figures • includes at least 6 data points per graph **data analysis:** • includes correct mathematical models of the graph for the curve best fitting the data **conclusion:** • includes the mathematical models (equations) which most accurately represent your data, discussing the physical meaning of the slope and y-intercept

Physics Midterm Exam Review
Graphical Analysis

Graph the following data sets using LoggerPro.

- *Graph the independent variable on the x-axis and the dependent on the y-axis.*
- *Enter data with the correct # of significant digits.*
- *Label your x- and y- axes with the variables being graphed and the units.*
- *Linearize your data if necessary on a second graph.*
- *Write a mathematical model that best fits the data.*
- *Make sure your slope and y-intercept have units.*
- *Remember the 5% rule for determining if the y-intercept may be set to zero.*

1) The volume of air in a syringe is changed by pushing the plunger. The pressure is then measured using a pressure sensor on a LabPro.

Pressure (torr)	Volume (mL)
100.0	800.0
200.0	400.0
400.0	200.0
600.0	133.0
700.0	114.0
800.0	100.0
1000.0	80.0

2) Photographs are taken of a ball rolling down a ramp with a timer or strobe light technique that snaps a picture every second. The distance the ball has gone from the top is measured every second on the photograph (from a scale made from knowing the length of the ramp in real life and in the picture).

Time (s)	Distance (m)
0.00	0.00
1.00	5.00
2.00	19.99
3.00	45.03
4.00	80.00
5.00	124.89

3) The speed of a race car with an amazing new accelerator is measured every second by looking at the speedometer.

Time (s)	Speed (m/s)
0.0	0.0
1.0	20.1
2.0	44.8
3.0	60.0
4.0	84.3
5.0	104.9

Note: We are only doing 3 out of 5 cases here. Make sure you know how to recognize the other two and what you need to do to linearize them.

Physics Midterm - Prelab

Experimental Design, Data Analysis and Mathematical Models

Prelab MUST be completed before the exam. This information on voltage, current, resistance and circuits is crucial to your understanding of the data you will be collecting. Completion will constitute 10 points of the exam grade.

Begin at the following URL and use the "next" arrow keys to navigate through the website and answer the questions.

http://www.ndt-ed.org/EducationResources/HighSchool/Electricity/electricalcurrent.htm

1) Define electricity.

2) Define current (amperage). In what unit is current (or amperage) measured?

3) What instrument is used to measure current?

4) Define emf (we will be calling this voltage). In what unit is emf (voltage) measured?

5) How can we create emf (voltage)?

6) Make an analogy using water to show how voltage and current (amperage) are related.

7) Define resistance. In what unit is resistance measured?

8) Continue the water analogy to help describe resistance.

Skip to

http://www.ndted.org/EducationResources/HighSchool/Electricity/seriesparallelcircuits.htm

9) What is a circuit?

In a circuit diagram, what is the symbol for a(n)

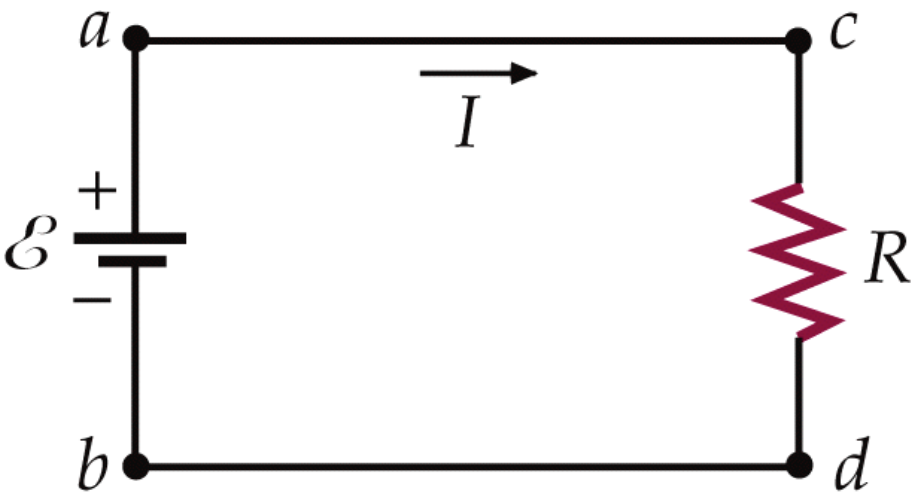
a) ammeter ?

b) voltmeter?

c) resistor?

d) battery?

10) When measuring the current in a circuit, the *ammeter* must be placed in series and the *voltmeter* in parallel. Explain the difference between series and parallel and draw the placement of an ammeter and voltmeter to measure the current through and the voltage across the resister in the following simple circuit.



Physics Midterm

Experimental Design, Data Analysis and Mathematical Models

Purpose:

To determine the relationship between **voltage**, **current**, and **resistance** in a DC circuit. First the relationship between voltage and current will be examined and then the relationship between resistance and current. The mathematical relationships for these two models will be combined into one equation showing the relationship between all three quantities.

Background information on Voltage, Current, and Resistance:

In order to talk meaningfully about electricity, and especially how we can *use* electricity, we need to be able to measure its fundamental properties. There are three primary characteristics that describe the nature of electrical flows.

The first is *voltage*, usually abbreviated "V" and measured in *volts* (also abbreviated "V".) Voltage, also sometimes called *potential difference* or *electromotive force (EMF)*, refers to the amount of potential energy the electrons have in an object or circuit. In some ways, you can think of this as the amount of "push" the electrons are making to try to get towards a positive charge. The more energy the electrons have, the stronger the voltage. If we draw an analogy to a waterfall, the voltage would represent the height of the waterfall: the higher it is, the more potential energy the water has by virtue of its distance from the bottom of the falls, and the more energy it will possess as it hits the bottom.

The second primary characteristic of electricity is *current*, usually abbreviated "I" ("C" is reserved for the principle of *charge*, the most fundamental building block of electricity.) Current is measured in *amperes* or *amps*, abbreviation "A". Current refers to how much electricity is flowing--how many electrons are moving through a circuit in a unit of time. If we think about our waterfall example, the current would represent how much water was going over the edge of the falls each second.

The third primary characteristic of electricity is *resistance*, normally abbreviated "R" and measured in *ohms*, abbreviated using the Greek letter *omega* (Ω). Resistance refers to how much the material that is conducting electricity opposes the flow of electrons. The higher the resistance, the harder it is for the electrons to push through. In the waterfall analogy, resistance would refer to any obstacles that slowed down the flow of water over the edge of the falls. Perhaps there are many rocks in the river before the edge, to slow the water down. Or maybe a dam is being used to hold back most of the water and let only a small amount of it through.

Hypotheses (follow guidelines on grading sheet):

current vs resistance:

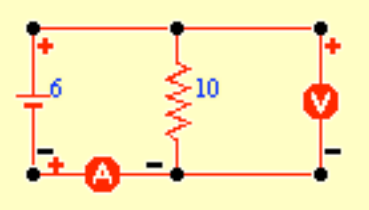
current vs voltage:

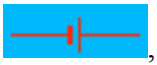
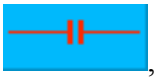
Procedure:

1) Open the Circuit Builder.

   http://webphysics.davidson.edu/Applets/circuitbuilder/default.htm

   Build a simple circuit containing a battery and a resistor in series. Place an ammeter in series in the circuit and a voltmeter in parallel across the resistor. To do this, drag the circuit elements into the desired spot on the circuit board schematic (use the picture below as a guide). To remove existing components, right click on them and choose "delete component".



Please note that the battery ,  , is NOT in the original circuit that comes up when you launch the simulation. You must delete the capacitor,  , and add in a battery.

2) Right click on the battery and resistor and choose "display value knob". These sliders will allow you to change the values of the voltage and the resistance. Try starting with a 6.0 V battery and a 10.0 Ω resistor. Move the windows so you can see both of them.

3) To show the readings on your meters, right click on your voltmeter and choose "display voltmeter". Do the same for the ammeter.

4) Gather data to determine the relationships between current and voltage and current and resistance. Note: make sure you are reading voltage and current values from the voltmeter and ammeter displays. Do not read the voltage value from the battery.

Data (on a separate sheet of paper, follow guidelines on grading sheet):

1) Construct data tables for your experiments.

2) Identify the independent and dependent variables in each case.

3) Record and identify all constants.

Data analysis (on a separate sheet of paper, follow guidelines on grading sheet):

1) Graph your data using correct graphing techniques, and print your graphs. If you are using a graphing calculator, include graphs of your original data by hand on graph paper (two graphs, one for voltage and current and one for resistance and current).

2) Determine the mathematical models for current vs voltage and for current vs resistance. Include all regression statistics given by graphical analysis or your graphing calculator.

Conclusion (on a separate sheet of paper):

Write your conclusion following the guidelines on the grading sheet. In addition, combine your two mathematical models into one model showing the relationship between V, I and R. (Hint: what do the slopes of each of your models mean? Compare them to values held constant during those experiments).

Scoring:

Prelab – 10 points	Hypotheses – 10 points	Procedure/Data – 20 points
Data analysis – 30 points	Conclusion – 30 points	