PHYSICS DEPARTMENT
College of Science
De La Salle University - Manila

DATA SHEET

COEFFICIENT OF LINEAR EXPANSION OF METALS

Experiment No. ________

Date:____________________ Subject & Section:____________________ Score:______________

Name:	ID No.:	Signature:

Material of metal rod		
Original length, L_1 (cm)		
Initial Temperature, T_1 (^oC)		
Final Temperature, T_2 (^oC)		
Short lever arm (cm)		
Long lever arm (cm)		
Lever arm ratio (Long arm / Short arm)		
Initial position of pointer		
Final position of pointer		
Change in scale reading (cm)		
Elongation of metal rod, DL (cm)		
Coefficient of linear expansion, a (1/ ^oC) (use equation 3)		
Standard value of a (1/ ^oC) (see Appendix, Table 3)		
Percent error		

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DATA SHEET

SPECIFIC HEAT OF SOLIDS

Experiment No. ________

Date:______________________ Subject & Section:______________________ Score:________________

Name:	ID No.:	Signature:

Material of metal specimen		
Mass of inner cup of calorimeter, m_C (g)		
Mass of water, m_w (g)		
Mass of stirrer, m_S (g)		
Mass of thermometer, m_t (g)		
Mass of speciment, m_m (g)		
Specific heat of inner cup of calorimeter, c_c (cal/g ^oC)		
Specific heat of water, c_W (cal/g ^oC)		
Specific heat of stirrer, c_s (cal/g ^oC)		
Specific heat of thermometer, c_t (cal/g ^oC)		
Initial temperature of cold water, T_W (^oC)		
Initial temperature of metal specimen, T_m (^oC)		
Final temperature of mixture, T_F (^oC)		
Calculated Specific Heat c_s (cal/g ^oC) (use equation 4)		
Standard Value of Specific Heat (cal/g ^oC) (see Appendix C, Table 2)		
Percent error		

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DATA SHEET

SPECIFIC HEAT OF SOLIDS
(*Using PASCO Scientific Equipment*)

Experiment No. ________

Date:________________________ Subject & Section:____________________ Score: _______________

Individual Report

Name:	ID No.:	Signature:

Material of metal sample		
Mass of calorimeter, m_{cal} (g)		
Mass of metal sample, m_{sample} (g)		
Mass of calorimeter, water, and metal sample, m_{total} (g)		
Mass of water, m_{water} (g)		
Temperature of water, T_{cold} (^oC)		
Equilibrium temperature of water and metal sample, T_{final} (^oC)		
Temperature of change of sample, DT_{sample} (^oC)		
Specific heat of water, c_{water} (cal/g ^oC)		
Calculated Specific Heat c_s (cal/g ^oC) (use equation 3)		
Standard Value of Specific Heat (cal/g ^oC) (see Appendix C, Table 2)		
Percent error		

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DATA SHEET

HEAT OF FUSION
(*Using PASCO Scientific Equipment*)

Experiment No. ________

Date:______________________ Subject & Section:__________________ Score: ______________

Name:	ID No.:	Signature:

Room Temperature, T_{room} (^oC)		
Mass of calorimeter, m_{cal} (g)		
Mass of calorimeter plus water, $m_{cal + water}$ (g)		
Mass of calorimeter plus water plus melted ice, m_{final} (g)		
Mass of water, m_{water} (g) $m_{water} = m_{cal + water} - m_{cal}$		
Mass of ice, m_{ice} (g) $m_{ice} = m_{final} - m_{cal + water}$		
Specific heat of water, c_{water} (cal/g ^oC)		
Initial temperature of warm water, $T_{initial}$ (^oC)		
Initial temperature of ice, T_{ice} (^oC)		
Final equilibrium temperature, T_{final} (^oC)		
Calculated Heat of Fusion, L_f (cal/g) (use equation 3)		
Standard Value of Heat of Fusion, (cal / g) (see Appendix C, Table 5)		
Percent error		

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DATA SHEET

HEAT OF VAPORIZATION

Experiment No. ________

Date:___________ Subject & Section:_____________________ Score:__________

Name:	ID No.:	Signature:

General Information on Equipment and Room Condition

Room Temperature = ____________________________ ^oC
Material of calorimeter =____________________________
Material of stirrer = ____________________________

Observed Data and Calculated Results

Specific heat of inner cup, c_c (cal/g ^oC)	
Specific heat of stirrer, c_s (cal/g ^oC)	
Specific heat of water, c_W (cal/g ^oC)	
Mass of inner cup, m_c (g)	
Mass of stirrer, m_s (g)	
Mass of inner cup + original (cold) water, (g)	
Mass of original (cold) water, m_W (g)	
Mass of inner cup + final contents, (g)	
Mass of condensed steam, m_v (g)	
Temperature of original water, inner cup, and stirrer, T_i (^oC)	
Temperature of steam, T_v (^oC)	
Final temperature of the mixture, T_f (^oC)	
Heat of vaporization measured, L_v (cal/g) (use equation 2)	
Standard Value of Heat of Vaporization, (cal / g) (see Appendix C, Table 5)	
Percent error	

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DATA SHEET

HEAT OF VAPORIZATION
(*Using PASCO Scientific Equipment*)

Experiment No. ________

Date:___________ Subject & Section:_____________________ Score:__________

Name:	ID No.:	Signature:

Mass of calorimeter, c_{cal} (g)	
Mass of calorimeter plus water, $c_{cal + water}$ (g)	
Total mass of calorimeter plus water plus condensed steam, m_{final} (g)	
Mass of water, m_{water} (g) $m_{water} = m_{cal + water} - m_{cal}$	
Mass of steam, m_{steam} (g) $m_{steam} = m_{final} - m_{cal + water}$	
Specific heat of water, c_{water} (cal/g ^oC)	
Room temperature, T_{room} (^oC)	
Initial temperature of water, $T_{initial}$ (^oC)	
Initial temperature of steam, $T_{initial}$ (^oC)	
Final equilibrium temperature, T_{final} (^oC)	
Calculated Heat of Vaporization, L_v (cal/g) (use equation 3)	
Standard Value of Heat of Vaporization, (cal / g) (see Appendix C, Table 5)	
Percent error	

PHYSICS DEPARTMENT
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DATA SHEET

VOLT-OHM-MILLIAMETER (VOM) & RESISTOR COLOR CODING

Experiment No. ________

Date: _____________ Subject & Section: _______________________ Score: ___________

Name:	ID No.:	Signature

I. VOM AS AN OHMMETER

A. CONTINUITY TEST

No. of wires in good condition:	No. of broken wires:

B. RESISTANCE MEASUREMENT

	Resistor 1	Resistor 2	Resistor 3
Color Code (color bands)			
Rated Value (based on color of bands)			
Maximum Rated Value = (reated value + tolerance)			
Minimum Rated Value = (reated value - tolerance)			
Ohmmeter Range Used			
Pointer Position in scale			
Actual Value from VOM			
Is the actual value w/in the max. & min. rated value?			

II. VOM AS A VOLTMETER

A. EXERCISE ON CHOOSING THE RIGHT RANGE

	Voltage Source / Device	Best Range
Example	220 V convenience power outlet	
1.	110 V convenience power outlet	
2.	12 V Car Battery	
3.	6 V DC Adapter	
4.	3 V Battery module or 3 V DC Power Supply	
5.	5 V peak square wave from signal generator	

B. DC VOLTAGE MEASUREMENT

Voltage Source	Estimated Voltage	Best Range	Scale	Position of pointer in scale	Actual Value
Battery					
Battery Module					

C. AC VOLTAGE MEASUREMENT

Voltage Source	Estimated Voltage	Best Range	Scale	Position of pointer in scale	Actual Value
Convenience Power Outlet	V				V

V_{RMS} = ____________________ V_{PEAK} = ____________________

III. VOM AS A DC AMMETER

Load	Estimated Current	Best Range	Scale	Position of pointer in scale	Actual Value
750 Ω					
100 Ω					

REVIEW QUESTIONS

1. Differentiate DC and AC voltages.
2. How are voltmeters connected in a circuit?
3. How are the polarities determined for DC and AC settings?
4. How are ammeters connected in a circuit?
5. What are the steps in measuring resistance, and how is the best meter range determined?

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DATA SHEET

OHMS LAW & RESISTIVITY - RESISTANCE

Experiment No. ________

Date:______________ Subject & Section:__________________________ Score:______________

Name:	ID No.:	Signature:

I. VARIATION OF VOLTAGE WITH CURRENT, RESISTANCE CONSTANT

Constant Resistance, R = 10 ohms

TRIAL	1	2	3	4	5
I (amperes)	0.05	0.10	0.15	0.20	0.25
V (volts)					

Slope from graph V vs. I = $R_{EXP'T}$ = __________ ohms

R_{THEO} = __________ ohms

% Error = __________ %

V vs. I Graph

Slope = ________Ω

II. VARIATION OF VOLTAGE WITH RESISTANCE, CURRENT CONSTANT

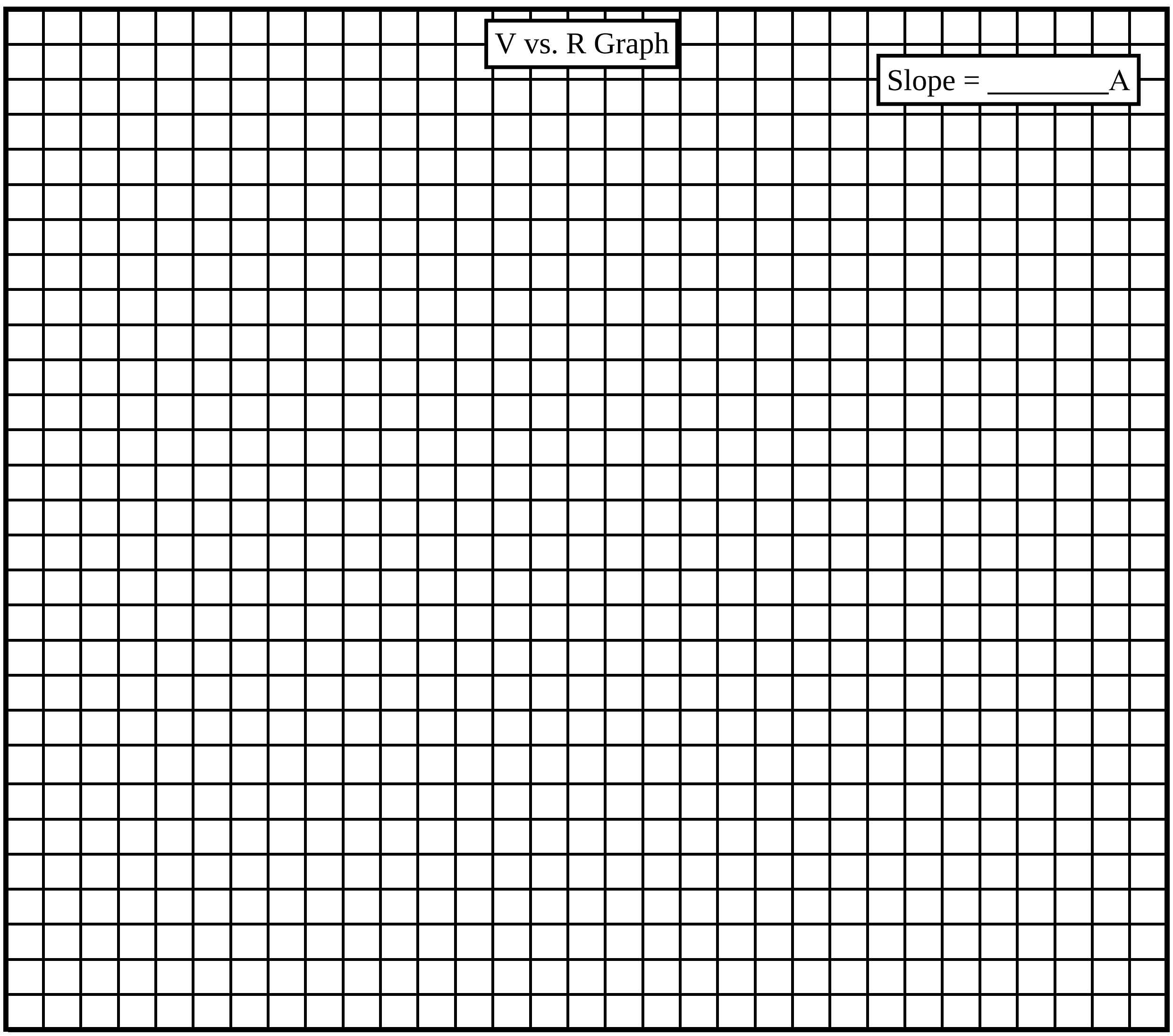
Constant Current, I = 0.05 amperes

TRIAL	**1**	**2**	**3**	**4**	**5**
R (ohms)	100	80	60	40	20
V (volts)					

Slope from graph V vs. R = $I_{EXP'T}$ = __________ amperes

I_{THEO} = ___0.05____ amperes

% Error = __________ %



III. VARIATION OF CURRENT WITH RESISTANCE, VOLTAGE CONSTANT

Constant Voltage, V = 2 volts

TRIAL	**1**	**2**	**3**	**4**	**5**
R (ohms)	100	50	30	25	20
1/R (mhos)					
I (amperes)					

Slope from graph I vs. 1/R = $V_{EXP'T}$ = __________ volts

V_{THEO} = ____2_____ volts

% Error = __________ %

I vs. 1/R Graph

Slope = ________V

IV. RESISTIVITY AND RESISTANCE

Metal = ____________________

$\rho_{STANDARD}$ = ______________________ Ωm

Diameter = _________________ m

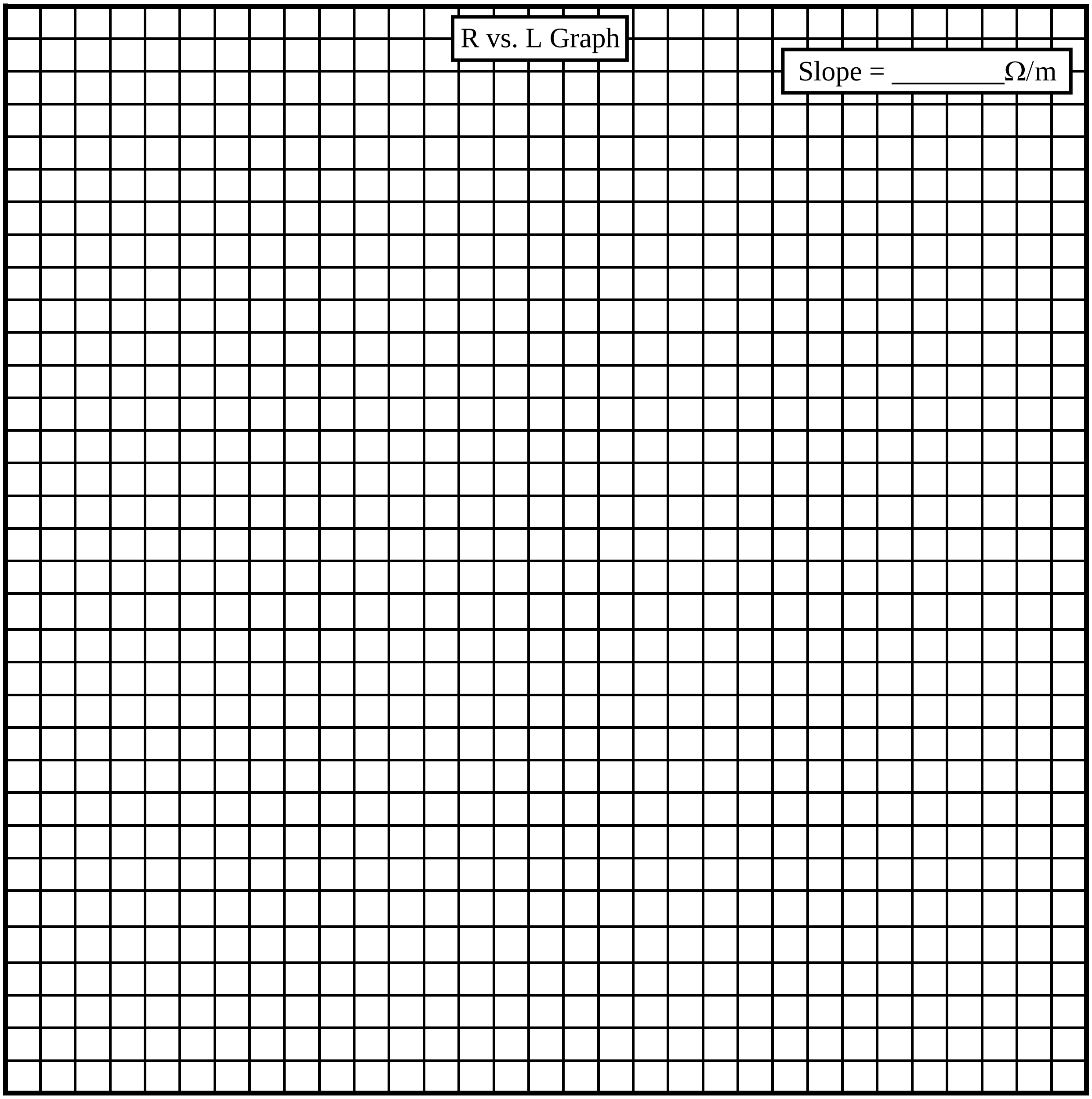
Cross-sectional area = ______________ m^2

Slope from graph = __________ Ω/m

$\rho_{EXP'T}$ = ___________________________ Ωm

Constant Current, I = 0.05 amperes

TRIAL	**1**	**2**	**3**	**4**	**5**
R (ohms)	100	80	60	40	20
V (volts)					



QUESTIONS

1. In Part IA of the epxeriment, what happened to the voltage across the resistance box as the current through it was increased? What is the relationship between voltage and current when resistance is fixed?
2. In Part IB, what happened to the voltage as resistance is decreased? What is the relationship between voltage and resistance when current is maintained constant?
3. In Part IC, what happened to the voltage as resistance is increased? What is the relationship between current and resistance when voltage is constant?
4. What happens to the resistance of a wire when its length is increased (at constant temperature)? when its cross-sectional area is increased?
5. A copper wire of length L and area A has resistance R. If we double its length and radius, what would be its new resistance?
6. Two wires, A and B, are made of the same material, have the same diameter, and are at the same temperature. Wire A is twice as long as wire B, and the same voltage is applied across the ends of each wire. If the current through wire A is I, what is the current through wire B?

ANSWERS

PHYSICS DEPARTMENT
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DATA SHEET

EMF, TERMINAL VOLTAGE, AND INTERNAL RESISTANCE

Experiment No. ________

Date:_______________ Subject & Section:____________________________ Score:_______________

Name:	ID No.:	Signature:

I. DANIELL CELL (WET CELL)

A. FIRST TRIAL

ε = ________________ volts

R (Ω)	**V_{ab} (volts)**	**I (A)**	**r (Ω)**
20			
40			
60			
80			
100			

Average r =_________________ Ω

V_{ab} vs. I

Slope =_______
r from slope =_______ Ω
y-intercept = ε = _______ V

A. SECOND TRIAL

ε = _______________ volts

R **(Ω)**	**V_{ab}** **(volts)**	**I** **(A)**	**r** **(Ω)**
20			
40			
60			
80			
100			

Average r =________________ Ω

V_{ab} vs. I

Slope =_______

r from slope =_______ Ω

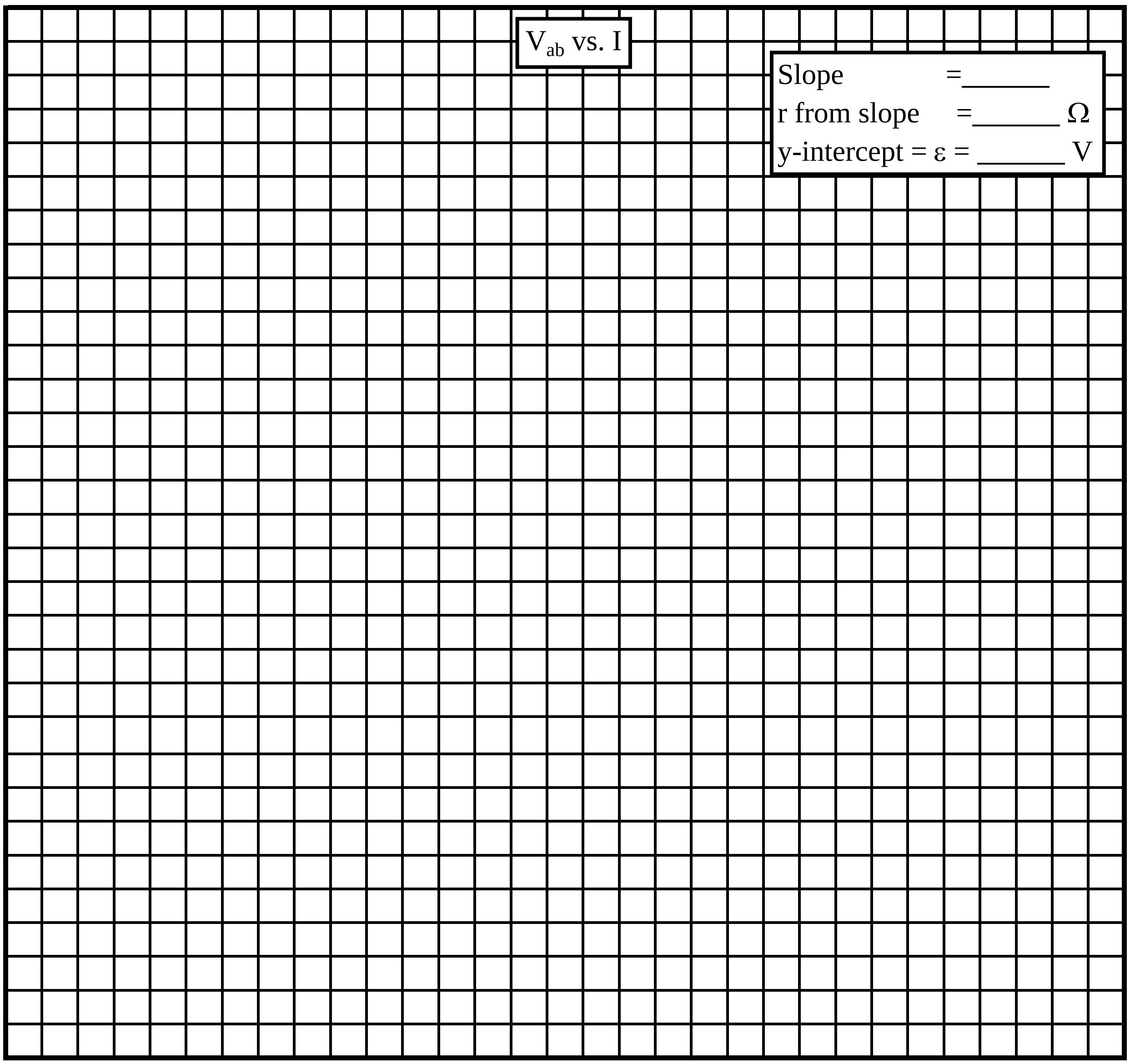
y-intercept = ε = _______ V

II. CARBON BATTERY (DRY CELL)

ε = _______________ volts

I (A)	V_{ab} (volts)	r (Ω)
0.05		
0.10		
0.15		
0.20		
0.25		

Average r =________________ Ω



QUESTIONS

1. Based on your data, what happens to the terminal voltage of the battery as the current through it is increased?
2. What is the significance of the slope of the terminal voltage vs. current (V_{ab} vs. I) graph? What is its unit?
3. What is the significance of the y-intercept of the terminal voltage V_{ab} vs. current I graph? What is its unit?
4. When the battery supplies power to the circuit, such as in this experiment, why is its terminal voltage V_{ab} less than its emf?
5. Under what condition is the terminal voltage of a battery greater thatn its emf? Less than its emf?
6. A battery with an emf of 12V and an internal resistance of 1Ω, is connected to a 15Ω resistor.
   (a) What is the current through the 15Ω resistor?
   (b) What is the terminal voltage across the battery?

ANSWERS

SAMPLE COMPUTATIONS

PHYSICS DEPARTMENT
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DATA SHEET

RESISTORS IN SERIES AND PARALLEL

Experiment No. ________

Date:______________ Subject & Section:__________________________ Score:______________

Name:	ID No.:	Signature:

I. RESISTORS IN SERIES

A. MEASUREMENTS

Decade Box's Resistance	Measured Voltage	Measured Current
$R_1 = 10\ \Omega$	$V_1 =$ volts	$I_1 =$ A
$R_2 = 20\ \Omega$	$V_2 =$ volts	$I_2 =$ A
$R_3 = 30\ \Omega$	$V_3 =$ volts	$I_3 =$ A
	Measured $V_T =$ volts	Measured $I_T =$ A

B. CALCULATIONS

1. Is $R_T = R_1 + R_2 + R_3$?

$R_T = V_T/I_T$	$R_T = R_1 + R_2 + R_3$	% difference
Ω	Ω	

2. Is $V_T = V_1 + V_2 + V_3$?

Measured V_T	$V_T = V_1 + V_2 + V_3$	% difference
volts	volts	

3. Is $I_T = I_1 = I_2 = I_3$?

Measured Total Current	Measured Individual Current	% difference
Measured $I_T =$ A	A	
	A	
	A	

II. RESISTORS IN PARALLEL

A. MEASUREMENTS

Decade Box's Resistance	Measured Voltage	Measured Current
$R_1 = 15\ \Omega$	$V_1 =$ volts	$I_1 =$ A
$R_2 = 30\ \Omega$	$V_2 =$ volts	$I_2 =$ A
$R_3 = 40\ \Omega$	$V_3 =$ volts	$I_3 =$ A
	Measured $V_T =$ volts	Measured $I_T =$ A

B. CALCULATIONS

1. Is $R_T = \dfrac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$

$R_T = V_T/I_T$	$R_T = \dfrac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$	% difference
Ω	Ω	

2. Is $I_T = I_1 + I_2 + I_3$?

Measured I_T	$I_T = I_1 + I_2 + I_3$	% difference
A	A	

3. Is $V_T = V_1 = V_2 = V_3$?

Measured Total Voltage	Measured Individual Voltage	% difference
Measured $V_T =$ volts	$V_1 =$ volts	
	$V_2 =$ volts	
	$V_3 =$ volts	

III. RESISTORS IN SERIES AND PARALLEL COMBINATION

A. MEASUREMENTS

Decade Box's Resistance	Measured Voltage	Measured Current
$R_1 = 10\ \Omega$	$V_1 =$ volts	$I_1 =$ A
$R_2 = 20\ \Omega$	$V_2 =$ volts	$I_2 =$ A
$R_3 = 30\ \Omega$	$V_3 =$ volts	$I_3 =$ A
	Measured $V_T =$ volts	Measured $I_T =$ A

B. CALCULATIONS

1. Is $R_T = R_1 + \dfrac{R_2 R_3}{R_2 + R_3}$?

$R_T = V_T/I_T$	$R_T = \dfrac{R_2 R_3}{R_2 + R_3}$	% difference
Ω	Ω	

2. Is $V_T = V_1 + V_2 = V_1 + V_3$?

Measured V_T	$V_T = (V_1 + V_2)$ or $(V_1 + V_3)$	% difference
A	A	

3. Is $I_T = I_1 = I_2 + I_3$?

Measured Total Voltage	Measured Individual	% difference
IT = A	$I_1 =$ A	
	$I_2 + I_3 =$ A	

QUESTIONS

1. Which measured quantity is the same/equal for all resistors in a series connection?
2. Which measured quantity is the same for all resistors in a parallel connection?
3. How should three equivalent resistors be connected to obtain the least equivalent resistance?
4. How are electrical appliances in household circuits connected?
5. How should an ammeter be placed in a circuit to measure the current through a device?
6. How should a voltmeter be connected to measure the voltage across a device?

ANSWERS

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DATA SHEET

KIRCHHOFF'S RULES

Experiment No. ________

Date:______________ Subject & Section:__________________________ Score:______________

Name:	ID No.:	Signature:

A. GIVEN RESISTORS AND MEASURED VOLTAGES

Resistors	Measured Voltages
R_1 = Ω	V_1 = volts
R_2 = Ω	V_2 = volts
R_3 = Ω	

B. CIRCUIT CALCULATIONS USING KVL AND KCL

Figure A. Circuit with assumed currents

KCL at node **e**: _______________
KVL around loop 1 (loop *abgfea*): ____
KVL around loop 2 (loop *efgdce*): ____

Solution for I_1, I_2, and I_3

C. MEASURED CURRENTS

Measured Currents (amperes)
I_1 =
I_2 =
I_3 =

Figure B. Circuit with correct direction of currents

D. COMPARISON

Current	Calculated Value (amperes)	Measured Value (amperes)	% Difference
I_1			
I_2			
I_3			

QUESTIONS

1. Why must both batteries/power sources be connected when the terminal voltage across each of them was measured?
2. What conservation law governs Kirchhoff's loop rule?
3. Which battery in the circuit supplies power to the circuit?
4. Which battery in the circuit is being charged or is absorbing power? State a general rule in determining which battery supplies power and which battery charges
5. What is the significance of a negative calculated value for current in a branch?

ANSWERS

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DATA SHEET

GALVANOMETERS, AMMETERS, AND VOLTMETERS

Experiment No. ________

Date:______________ Subject & Section:__________________________ Score:______________

Name:	ID No.:	Signature:

I. MEASUREMENT OF THE GALVANOMETER'S RESISTANCE R_G

Galvanometer resistance $R_2 = R_G =$ ________________ Ω

II. CALCULATION OF GALVANOMETER'S CURRENT SENSITIVITY S_G

Full-scale deflection current of galvanometer $I_G =$ _______________ μA   = ________________A

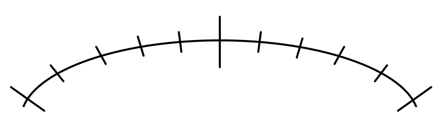
No. of scale division   n = ________________ divisions

Galvanometer sensitivity $S_G =$ _______________ μA/div

III. CONSTRUCTION OF A 10-mA AMMETER

I = __10×10^{-3}__ amperes
$R_S =$ _________ Ω

New meter scale:



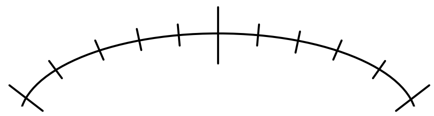
Measured Current I		% Difference
Standard Ammeter	**Constructed Ammeter**	
mA	mA	

IV. CONSTRUCTION OF A 5-V VOLTMETER

V = _____5_____ volts

R_M = ___________ Ω

New meter scale:



Measured Voltage V		
Standard Voltmeter	**Constructed Voltmeter**	**% Difference**
volts	volts	

QUESTIONS

1. In constructing an ammeter, how should the shunt resistor be connected to the galvanometer
2. Why must the shunt resistance of an ammeter be very small?
3. In constructing a voltmeter, how should the multiplier resistor be connected to the galvanometer?
4. Why must the multiplier resistance of the voltmeter be very large?
5. To construct a voltmeter with a maximum range of 250 volts, what value of multiplier resistance must be used? The galvanometer resistance is 100 ohms and the maximum deflection current of a galvanometer is 500 microamperes
6. The resistance of a galvanometer coil is 100Ω and the current for full-scale deflection is 500μA.
   - 6.1 What shunt resistance must be used to construct an ammeter with a full-scale deflection of 1 ampere?
   - 6.2 Compute the multiplier resistance needed to construct a voltmeter with a full scale deflection of 250 volts?

ANSWERS

SAMPLE COMPUTATIONS

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DATA SHEET

MAGNETIC FIELD

Experiment No. ________

Date:______________ Subject & Section:_________________________ Score:_____________

Name:	ID No.:	Signature:

I. MAGNETIC FIELD OF A PERMANENT MAGNET

1. How does using iron filings differ from using a magnetic compass to map magnetic field lines? How is it similar to using a magnetic compass to map magnetic field lines?

2. In terms of force or torque on a magnetic compass needle, what do the lines actually represent? Explain.

3. Do the lines ever cross each other at any point? Explain.

4. Where do the lines appear to be concentrated the most? What does this means?

II. MAGNETIC FIELD OF AN ELECTROMAGNET

1. What determines the direction of a magnetic field around a current-carrying wire? Provide evidence for your answer.

2. What determines the strength of a magnetic field around a current-carrying wire? Provide evidence for your answer.

3. Which is stronger, an electromagnet with an iron core or an electromagnet without an iron core? Explain.

A. Direction and Strength of Magnetic Field around an Electromagnet without an Iron Core

Wire Coil	Direction of Current	Direction of Deflection	Amount of Deflection
With most number of turns			
With most turns (current reversed)			
With fewer number of turns			
With fewer turns (current reversed)			
Single Wire			
Single Wire (current reversed)			