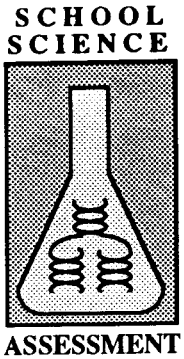


SCIENCE LABORATORY TEST

PHYSICS

These tests are being developed through
the University at Buffalo and NORC with support of
the National Science Foundation and
the U.S. Office of Education

Administrator's Manual
for
Science Laboratory Tests
in Physics

This packet of information is intended to accompany the science laboratory tests in physics. The Administrator's Manual consists of the following sections:

1. Introduction
2. Instructions to students students
   -Task station schematic
3. Teacher notes for each task including equipment and materials lists
4. Student test booklets

These tests were designed by Joan Boorman, State University College at Buffalo and Rodney L. Doran, State University at Buffalo, Buffalo, NY.

Revised 1993

1. Introduction

It was clear to us from the beginning of our work that the success of this alternative form of assessment depends strongly on the science teacher who administers the tasks. Therefore, we have prepared a series of guidelines, with attention to set-up of the equipment, administering the tasks, and scoring the students' responses. We have found that one teacher can effectively monitor the work of 12 students, two working on each of the six tasks. The titles of the six tasks in physics are:

1. Hooke's Law
2. Acceleration
3. The Pendulum
4. Snell's Law
5. Electric Circuits
6. Magnetic Fields

Each task is composed of two booklets labelled Part A and Part B, respectively. In Part A, students were given a problem and asked to plan and design an experiment using the material and equipment provided at their laboratory station. Students were asked to generate hypotheses and formulate a plan that would include an appropriate procedure that could be used to solve the problem. Students were encouraged to manipulate the equipment and write down an appropriate strategy for the solution of the problem, paying attention to safety precautions in a laboratory. They were also asked to suggest methods for organizing the data to be collected, and to suggest appropriate calculations necessary to make inferences. At the conclusion of 30 minutes, the student's plan was collected.

In Part B, students were given a test booklet that provided a detailed plan for data collection and suggestions for organizing the data leading to appropriate graphs, calculations, and conclusions. A student who did not come up with an appropriate plan in Part A could still perform the tasks and obtain credit for work completed. Thus, the detailed plan provided in Part B eliminated "double jeopardy" situations by not requiring the students to proceed with an inaccurately conceived plan from Part A.

The elements of each booklet are outlined in the following figures:

Task Format: PART A - DESIGN

— Introduction
— Problem
— Materials
— Experiment Design

TIME: 30 minutes

Task Format: PART B - EXPERIMENTS

— Instructions
— Procedure
— Safety
— Results/Observations
— Calculations
— Conclusions

TIME: 50 minutes

A total of 80 minutes for student "time on task" is required. With a few minutes of introduction, assignment to task, and collection of booklets, one should schedule a time block of 90 minutes for the testing. The students stay at the same station for the entire 90 minute period. The equipment is available for student familiarity and manipulation during Part A, but they are reminded that performance using the equipment comes later, in Part B.

The teacher responsibilities begin several weeks before the testing. We have assembled a list of the major tasks and timeline for this completion.

1. Reserve room	4 weeks prior to testing
2. Assign student to testing period (include alternates if part of plan)	4 weeks prior to testing
3. Plan for alternative activities for those <u>not</u> being tested.	4 weeks prior to testing
4. Locate equipment and material for tasks	2 weeks prior to testing
5. Assemble, prepare and trial-test equipment	2 weeks prior to testing
6. Copy student test booklets	1 week prior to testing
7. Assemble (and try) equipment and materials as needed for first period testing.	Day before testing
8. Assemble equipment and material for other testing in preparation area.	Day before testing
9. Check with principal and other teachers for duties on testing day	Day before testing

On the testing day, your responsibilities include the following:

1. Assign each student to appropriate station for the task they will do.
2. Assign alternates to task if some students are absent.
3. Send extra alternates to study hall or other planned space or activity.
4. Make students feel welcome. Begin reading directions.
5. Mark beginning time.
6. Check each station to be sure equipment and material are working correctly.
7. Answer questions, usually with the comment, "Reread the directions and do the best you can."
8. When 30 or 40 minutes has elapsed, read directions for changing to next stations or to Part B.
9. Collect Part A booklets and give students Part B booklets.
10. At the end of 80 minutes, read directions for end of testing.
11. Collect student booklets and thank them again as they leave.
12. Check stations. Clean up and replenish material for next students.

Once all the tests have been administered, training sessions for the scoring process should be scheduled. A scoring team should consist of teachers experienced in teaching the content area being assessed. We believe the scoring should <u>not</u> be done just by the teacher of the students being tested. If there are several teachers of a science area, they could each be trained to score a few tasks rather than all six tasks, becoming specialists on those tasks.

The training process should be planned to allow at least five hours. The following outline includes the recommended strategies for developing scorers that can validly and reliably score these tasks.

1. Review the laboratory tasks, including the student test booklets and the equipment/material lists.
2. Discuss the scoring form and criteria sheets and the procedure for using these.
3. Review the exemplars which are scored answers from student test booklets. Discuss the rationale for scoring each exemplar.
4. Score a group of 10 test booklets of the task for which you are being trained.
5. Discuss with the experienced scorer/trainer the scoring of each item on the scoring form. Determine the percent agreement with the trainer.
6. Repeat steps 4 and 5 until the desired level of agreement has been reached (usually 90 %).

DIRECTIONS
PHYSICS LAB TESTS

2. Instructions to Students

As students enter the room, they should be instructed to sit at one of the stations for their assigned task (numbered one through six). When the students are seated, let them look around the room, then instruct them to look at the equipment in front of them and find their test booklet. Tell the students NOT to touch the equipment until they are told to do so.

When the students have settled, the supervising teacher should read the following text. For ease in administration, all sections to be read are printed in italics.

Good morning (afternoon). My name is _____. Today, we are going to perform some science experiments. A booklet explaining the experiment you are to do should be in front of you. If you cannot find your booklet or you do not have a pencil, please raise your hand.

DISTRIBUTE NEEDED TEST BOOKLETS AND/OR PENCILS.

Now that each of you has a test booklet and pencil we are ready begin. Listen very carefully to the instructions. Please write your name, your sex, your school and today's date in the space provided on the front page of the booklet.

GIVE THE STUDENTS TIME TO DO THIS.

This is a science laboratory test. The equipment and material that you will need have been set out in front of you. You will be at this station for this entire test. Your booklet will give you specific directions. Write the results of your experiments in your booklet.

The science laboratory test is very different than the other science tests that you completed. We are trying to see how testing of science laboratory skills can be done in US high schools. Your responses are very important to us in this project.

Your individual performance will not be used as part of any science grade or evaluation for you. We ask you to do your best so we can learn as much as possible about this alternative method of testing.

Turn to the first page in your booklet.

MAKE SURE EVERYONE IS AT THE CORRECT PAGE IN THE BOOKLET

The physics test is organized into two parts, A and B. In part A, you will do three tasks. You should spend no more ten minutes on the first two tasks. The third task has been scheduled for twenty minutes of your time. When the time allowed for Part A (30 minutes) has elapsed, I will collect your booklet for Part A and give you the booklet for Part B.

Once you have started your experiment, I cannot help you. I can only assist you right now if you have any materials missing. Please read all directions carefully before you start to work.

We are now ready to begin the test. Are there any questions? Do your best. You may begin.

AFTER 30 MINUTES, COLLECT THE PART A BOOKLETS
AND GIVE THE PART B BOOKLETS.

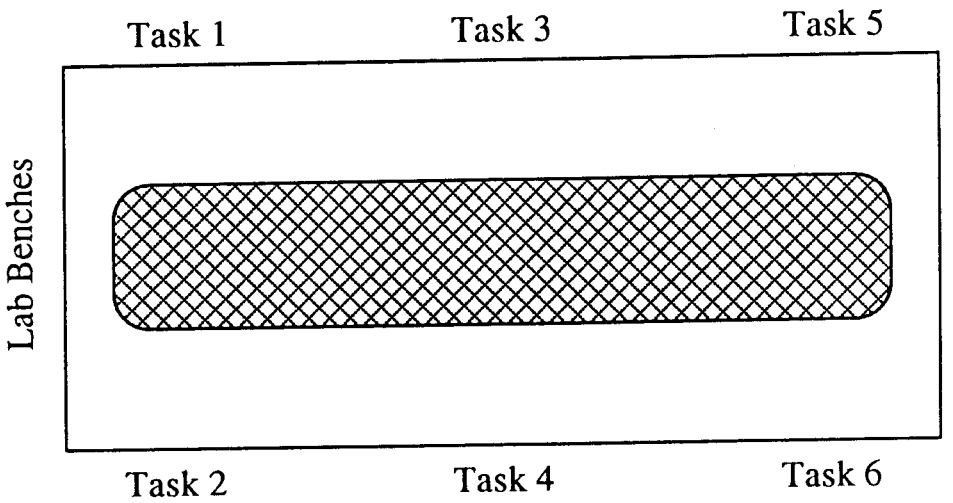
You will have 50 minutes for Part B. You may begin.

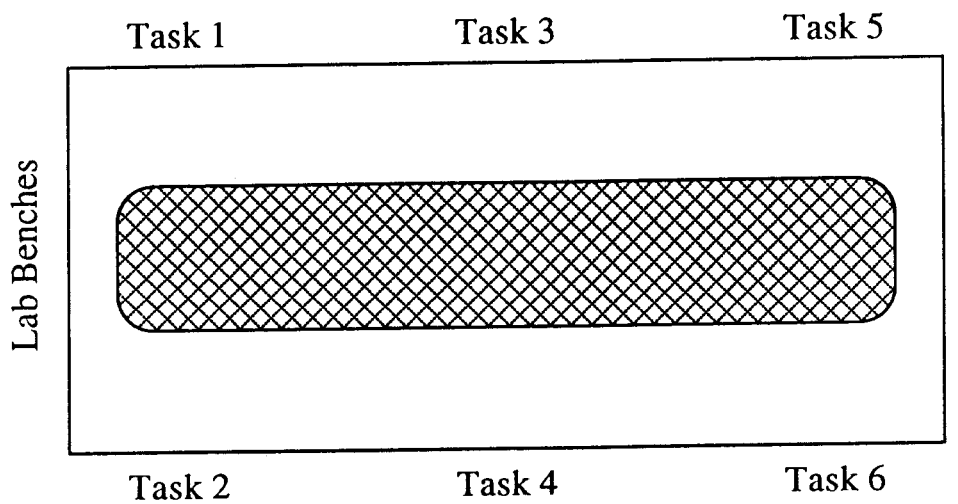
AFTER THE STUDENTS HAVE COMPLETED THE TEST (a total of 80 minutes)
READ FOLLOWING INSTRUCTIONS

This is the end of the science laboratory test. Please pass in your booklet and pencils.

Thank you for being so attentive and cooperative during the test. Please wait to be dismissed.

Station Set-up for Physics





3. Teacher Notes

Teacher Notes provide the information which enables the teacher to gather and prepare materials for set-up of the tasks or stations. Suggestions for performance and calculation of results for each physics task are also given. The sections included are:

Materials: Lists the amounts and sizes of all equipment and materials needed for each task.

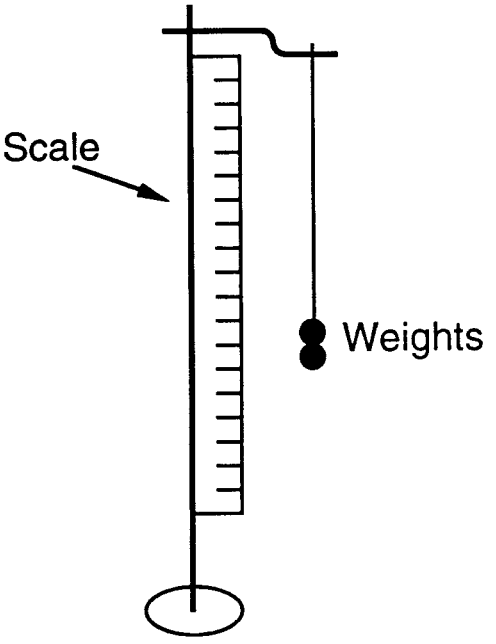
Safety: Gives suggestions regarding safety considerations specific to each task. In some tasks disposal methods are suggested.

Preparation: Specifies masses, volumes, concentrations, and directions for preparation of the needed materials and samples.

Hints and Clues: Provides suggestions aimed at helping the teacher through a "trial run" of the experiment.

Materials and Equipment
Physics Laboratory Skills Test

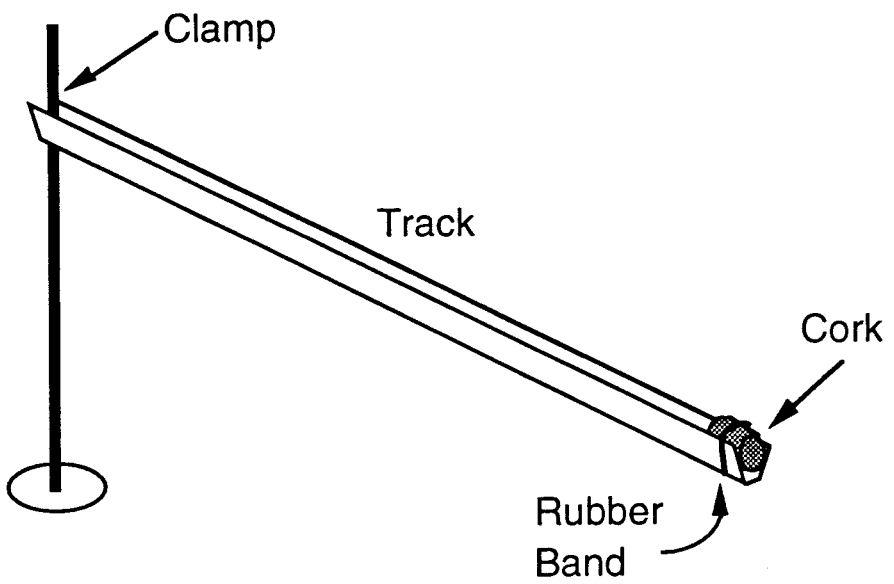
SUPPLIES	NOTES
a set of masses (not more than 1 kg. total mass) Hooke's Law Apparatus (or a ring stand, clamp and metric ruler) Sample Spring A C-clamp graph paper calculator	*The objective is to have students determine whether their spring will stretch 0.3m when 15N is attached. They should* ***not*** *have 15N available to make this determination.*



Task 1.3

Materials and Equipment
Physics Laboratory Skills Test

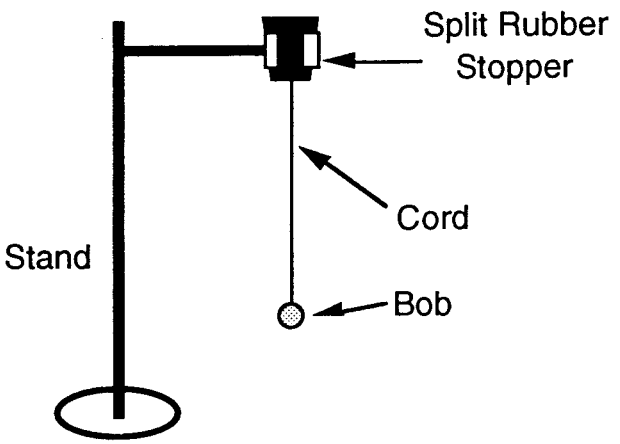
SUPPLIES	NOTES
1.5 m. metal track meter stick rubber stopper stopwatch a metal ball graph paper calculator	label the track; 0.25m, 0.50m, 0.75m, 1.00m, 1.25m, 1.50m (from the front of the cork) *Set the track at approximately a 30° angle.*



Task 2.3

Materials and Equipment
Physics Laboratory Skills Test

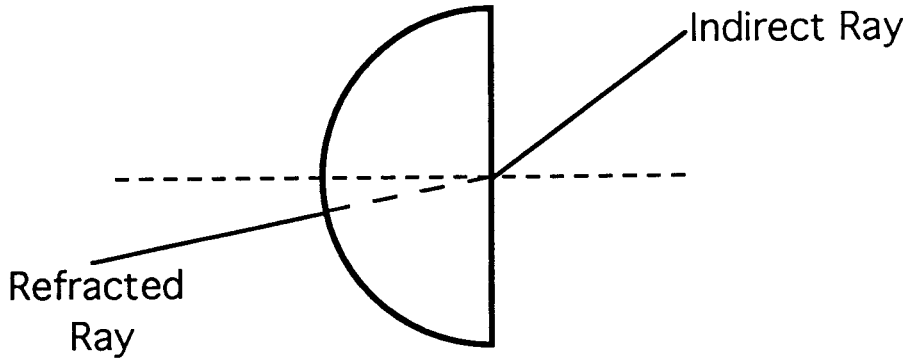
SUPPLIES	NOTES
adjustable clamp stand C-clamp (to fasten ring stand to the tabletop) stopwatch half-split stopper cord (maximum length 1 meter) meter stick graph paper calculator	*Students will be determining the period of a pendulum., at several different lengths. They should* ***not*** *have a length of cord greater than 1m. Their determination should be based on extrapolation of graphical data.*



Task 3.3

Materials and Equipment
Physics Laboratory Skills Test

SUPPLIES	NOTES
Corn Syrup A (glucose solution) semi-circular dish straight pins polar co-ordinate paper cardboard calculator metric ruler protractor plain paper	*Students will not have to trace the rays through the syrup, the tracings will be supplied to them. The ray diagram is in the student booklet. They will only be interpreting the data. The equipment is made available to help them in Part A.*



Materials and Equipment
Physics Laboratory Skills Test

SUPPLIES	NOTES
2-20 ohm (2watt) resistors ammeter 10 connecting leads knife switch 6 Volt battery voltmeter	*If 20 ohm resistors or 6 volt batteries are not available, choose resistors to match your power supply, or use two lamps.*

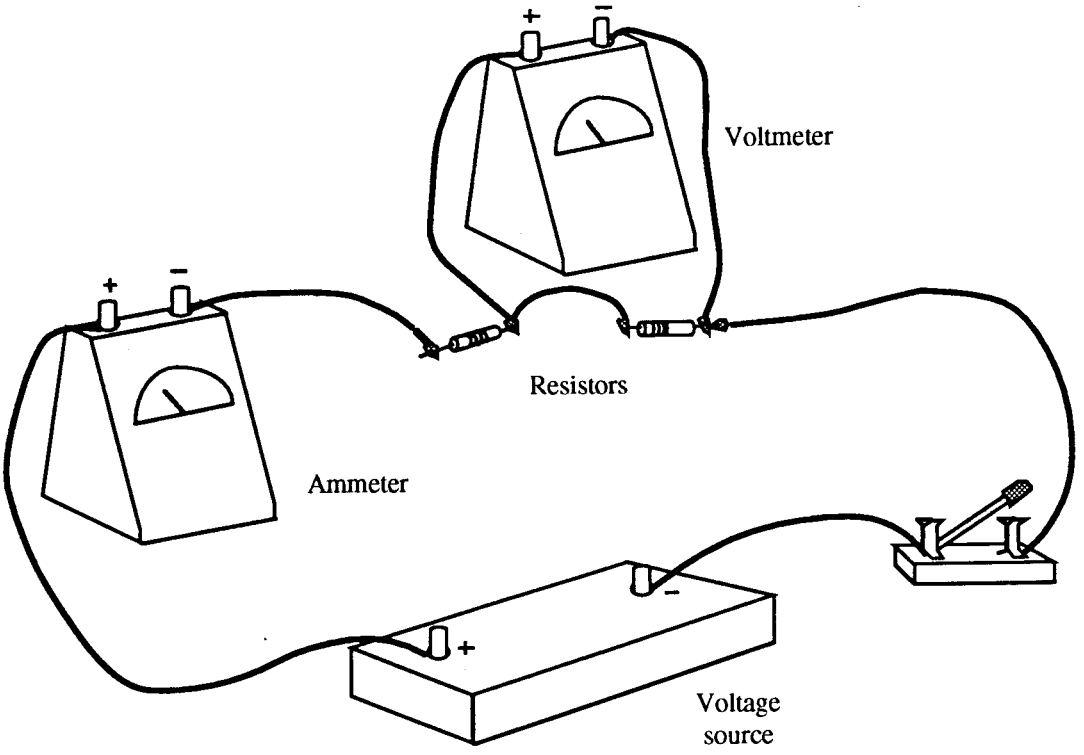


Figure 5.1

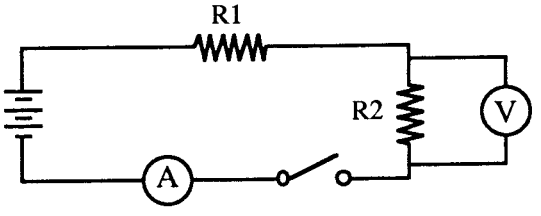
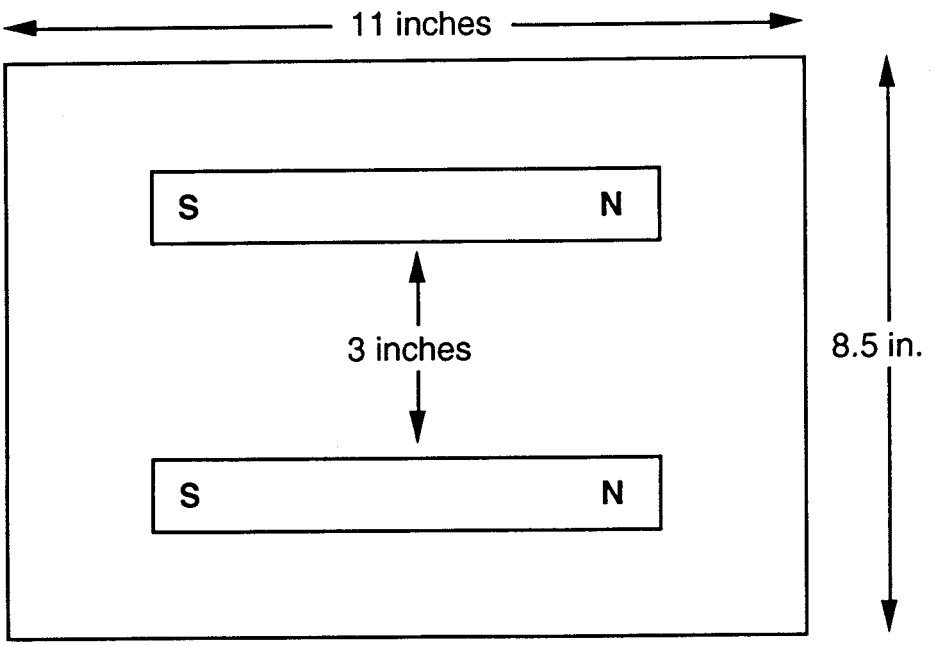


Figure 5.2

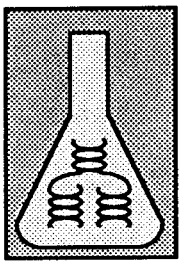
Materials and Equipment
Physics Laboratory Skills Test

SUPPLIES	NOTES
container of iron filings white paper compass *mystery* box	*Make the mystery box from some small thin box (Transparency Master box work well). Glue or tape two bar magnets on the bottom and seal the box securely with tape.*



Task 6.3

SCHOOL SCIENCE



ASSESSMENT

SCIENCE LABORATORY TEST

PHYSICS

TASK NUMBER 1
HOOKE'S LAW

PART A

TIME : 30 MINUTES

NAME _____ SEX _____

SCHOOL _____ DATE _____

These tests are being developed through
the University at Buffalo and NORC with support of
the National Science Foundation and
the U.S. Office of Education

LABORATORY TEST #1
Hooke's Law - Part A

Introduction

This laboratory test presents a problem and lists materials available to you. Your task is to design a strategy for solving the problem. Please record all your answers on these sheets. You will have 30 minutes to plan and design an experiment to solve the problem.

Problem

You will remember that Hooke's Law describes the relationship between the force applied to a spring and its elongation (stretch). That is, if a force stretches a spring, the elongation is directly proportional to the force applied.

F = kx Where: F = force in newtons
k = spring constant in newtons/meter
x = elongation in meters

Imagine that you work for a spring manufacturer and your job is to determine whether Sample Spring A will elongate to exactly 0.3 meters when a force of 15 newtons is applied. Your job is to conduct an experiment which will determine whether Sample Spring A meets this specification.

a) Under the heading **PROCEDURE** list in order the steps of the procedure you will use to solve the problem. You may include a diagram to help illustrate your plans for the experiment. Include any safety procedures you would follow.

b) Construct a **DATA TABLE** or indicate any other method that you could use to record the observations and results that will be obtained.

c) At the end of the 30 minutes, your answer sheet for Part A will be collected.

PLEASE NOTE: In Part A, you are NOT to proceed with any part of the actual experiment. You are just to plan and organize a way to investigate the problem.

Materials

a set of masses which totals 1kg
Hooke's Law Apparatus (or equivalent)
graph paper
Sample Spring A
C-clamp
calculator

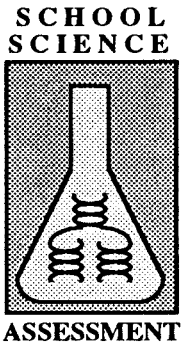
EXPERIMENT REPORT #1 - Part A

Organize your experiment under the following headings:
PROCEDURE and DATA TABLE
Use the front and back of these sheets if necessary.

PROCEDURE

EXPERIMENT REPORT #1 - Part A

DATA TABLE (For results and observations)



SCIENCE LABORATORY TEST

PHYSICS

TASK NUMBER 1
HOOKE'S LAW

PART B

TIME : 50 MINUTES

NAME _____ SEX _____

SCHOOL _____ DATE _____

These tests are being developed through
the University at Buffalo and NORC with support of
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LABORATORY TEST#1
Hooke's Law - Part B

Introduction

You will have 50 minutes to complete this part. You have been provided with a detailed Procedure (see next page) which you are to follow. Record your work for Part B on the answer sheet under the appropriate headings.

Problem

You will remember that Hooke's Law describes the relationship between the force applied to a spring and its elongation (stretch). That is, if a force stretches a spring, the elongation is directly proportional to the force applied.

F = kx Where: F = force in newtons
k = spring constant in newtons/meter
x = elongation in meters

Imagine that you work for a spring manufacturer and your job is to determine whether Sample Spring A will elongate to exactly 0.3 meters when a force of 15 newtons is applied. Your job is to conduct an experiment which will determine whether Sample Spring A meets this specification.

a) Perform the experiment by following the steps outlined in the procedure.

b) Under the heading **RESULTS/OBSERVATIONS** record the data collected in the experiment. Use statements, descriptive paragraphs, and tables of data where appropriate.

c) Under the heading **CALCULATIONS** show all equations and calculations used.

d) Construct a **GRAPH** that shows the relationship between the variables measured.

e) Under the heading **CONCLUSION** give an interpretation of your results.

f) At the end of the 50 minutes, your answer sheets will be collected.

Materials

a set of masses which totals 1kg
Sample Spring A
graph paper
Hooke's Law Apparatus
C-clamp
calculator

EXPERIMENT REPORT #1 - Part B

Complete the Procedure as given on these sheets.
Record your Results in the table provided.

PROCEDURE

1. Check the attachment of Sample Spring A and adjust the pointer to zero on the centimeter scale.

2. Attach increasing amounts of mass. Record both the total mass added and the total elongation of the spring. Use the Data Table provided.

3. Calculate the force of gravity acting on each mass in newtons. (**W = mg, g = 9.8 m/sec^2**)

4. Plot a graph of force against elongation, where the scale of values for force include **0 to 20** newtons and values for meters include **0 to 0.4** meters.

5. Use the graph to determine the force constant of the spring. **Show all calculations**. The slope is:

$$\mathbf{k = \frac{\Delta F}{\Delta x}}$$

Where: k = force constant
ΔF = force
Δx = elongation

6. Determine whether spring A can stretch to exactly 0.3 meters with a force of 15 newtons applied, by extending the graph through to force = 15 newtons.

7. Report your analysis of this problem under Conclusion.

OBSERVATIONS/RESULTS

Trial#	Mass (kg) [1000g = 1kg]	Force (N) W = mg	Elongation with no load (m)	Elongation with load (m)
1			0	
2			0	
3			0	
4			0	
5			0	
6			0	
7			0	
8			0	

EXPERIMENT REPORT #1 - Part B

Record your Calculations, Graph, and Conclusion on these sheets.

CALCULATIONS

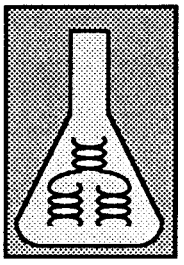
GRAPH

EXPERIMENT REPORT #1 - Part B

CONCLUSION

Based on a graphical analysis of the data you collected in this experiment, discuss your conclusion as to whether spring A could stretch to exactly 0.3 meters if a force of 15 newtons is applied. Be certain to explain how you used your data to arrive at this conclusion.

SCHOOL SCIENCE



ASSESSMENT

SCIENCE LABORATORY TEST

PHYSICS

TASK NUMBER 2
ACCELERATION

PART A

TIME : 30 MINUTES

NAME _____ SEX _____

SCHOOL _____ DATE _____

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LABORATORY TEST #2
Acceleration - Part A

Introduction

This laboratory test presents a problem and lists materials available to you. Your task is to design a strategy for solving the problem. Please record all your answers on these sheets. You will have 30 minutes to plan and design an experiment to solve the problem.

Problem

One of Galileo's most significant experiments was his measurement of acceleration. He rolled a brass ball down a wooden ramp and determined its acceleration using his pulse as a timer!

Using the equipment provided, your task is to conduct an experiment for determining the acceleration of the ball along an inclined plane. You will recall that acceleration is:

$$a = \frac{\Delta v}{\Delta t}$$

Where: a = acceleration
Δv = the change in velocity
Δt = the change in time

a) Under the heading **PROCEDURE** list in order the steps of the procedure you will use to solve the problem. You may include a diagram to help illustrate your plans for the experiment. Include any safety procedures you would follow.

b) Construct a **DATA TABLE** or indicate any other method that you could use to record the observations and results that will be obtained.

c) At the end of the 30 minutes, your answer sheet for Part A will be collected.

PLEASE NOTE: In Part A, you are NOT to proceed with any part of the actual experiment. You are just to plan and organize a way to investigate the problem.

Materials

metal track
rubber stopper
a metal ball
a calculator
a meter stick
a stopwatch
graph paper

EXPERIMENT REPORT #2 - Part A

Organize your experiment under the following headings:
PROCEDURE and DATA TABLE
Use the front and back of these sheets if necessary.

PROCEDURE

EXPERIMENT REPORT #2 - Part A

DATA TABLE (For results and observations)

SCHOOL SCIENCE ASSESSMENT

SCIENCE LABORATORY TEST

PHYSICS

TASK NUMBER 2
ACCELERATION

PART B

TIME : 50 MINUTES

NAME _____ SEX _____

SCHOOL _____ DATE _____

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the U.S. Office of Education

LABORATORY TEST #2
Acceleration - Part B

Introduction

You will have 50 minutes to complete this part. You have been provided with a detailed Procedure (see next page) which you are to follow. Record your work for Part B on the answer sheet under the appropriate headings.

Problem

One of Galileo's most significant experiments was his measurement of acceleration. He rolled a brass ball down a wooden ramp and determined its acceleration using his pulse as a timer!

Using the equipment provided, your task is to conduct an experiment for determining the acceleration of the ball along an inclined plane. You will recall that acceleration is:

$$a = \frac{\Delta v}{\Delta t}$$

Where: a = acceleration
Δv = the change in velocity
Δt = the change in time

a) Perform the experiment by following the steps outlined in the procedure.

b) Under the heading **RESULTS/OBSERVATIONS** record the data collected in the experiment. Use statements, descriptive paragraphs, and tables of data where appropriate.

c) Under the heading **CALCULATIONS** show all equations and calculations used.

d) Construct a **GRAPH** that shows the relationship between the variables measured.

e) Under the heading **CONCLUSION** give an interpretation of your results.

f) At the end of the 50 minutes, your answer sheets will be collected.

Materials

metal track
rubber stopper
a metal ball
a calculator
a meter stick
a stopwatch
graph paper

EXPERIMENT REPORT #2 - Part B

Complete the Procedure as given on these sheets.
Record your Results in the table provided.

Procedure

1. Check the set up of the track and fasten the stopper at the end of the ramp. Adjust the ramp until the ball rolls freely without pushing the stopper away.
2. Measure the time taken for the object to roll 0.25 m down the ramp from rest. Record the time. Repeat twice.
3. Continue to roll the ball from from rest at positions; 0.50 m, 0.75 m, 1.00 m, and 1.25m and 1.50 m. Record times in the Data Table.
4. Calculate and record the average time of Trials 1, 2, and 3 for each distance.
5. Using the distance and the average time, calculate the average speed (v).
6. Calculate final speed as twice the average speed.
7. Plot a graph of final speed against average time.
8. Use the slope of the graph to determine the ball's acceleration down the ramp. The slope is:

$$a = \frac{\Delta v}{\Delta t}$$

Where: a = acceleration
Δv = the change in velocity
Δt = the change in time

Data Table

Distance (m)	Trial 1 Time (sec)	Trial 2 Time (sec)	Trial 3 Time (sec)	Avg. Time (sec)	Average Speed (m/sec)	Final Speed (m/sec)
0.25						
0.50						
0.75						
1.00						
1.25						
1.50						

EXPERIMENT REPORT #2 - Part B

Record your Calculations, Graph, and Conclusion on these sheets.

CALCULATIONS

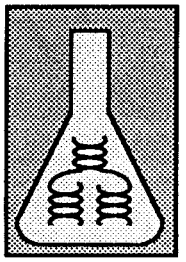
GRAPH

EXPERIMENT REPORT #2 - Part B

CONCLUSION

Based on a graphical analysis of the data you collected in this experiment, discuss the acceleration of the steel ball as it rolled down the ramp. Be certain to explain how you used your data to arrive at this conclusion.

SCHOOL SCIENCE



ASSESSMENT

SCIENCE LABORATORY TEST

PHYSICS

TASK NUMBER 3
THE PENDULUM

PART A

TIME : 30 MINUTES

NAME _____ SEX _____

SCHOOL _____ DATE _____

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the National Science Foundation and
the U.S. Office of Education

LABORATORY TEST #3
The Pendulum - Part A

Introduction

This laboratory test presents a problem and lists materials available to you. Your task is to design a strategy for solving the problem. Please record all your answers on these sheets. You will have 30 minutes to plan and design an experiment to solve the problem.

Problem

Imagine that you are working for a company which makes grandfather clocks of all different sizes. Donald Trump wants to buy a large customized clock for the top of Trump Tower and your job is to determine how long to make the pendulum so that it will have a period of 2 seconds.

You remember from your Physics class that the length of the pendulum determines the period of the pendulum's swing. Using the equipment supplied, you will conduct an experiment which will allow you to accurately determine what length the pendulum will need to be to have a 2 second period.

a) Under the heading **PROCEDURE** list in order the steps of the procedure you will use to solve the problem. You may include a diagram to help illustrate your plans for the experiment. Include any safety procedures you would follow.

b) Construct a **DATA TABLE** or indicate any other method that you could use to record the observations and results that will be obtained.

c) At the end of the 30 minutes, your answer sheet for Part A will be collected.

PLEASE NOTE: In Part A, you are NOT to proceed with any part of the actual experiment. You are just to plan and organize a way to investigate the problem.

Materials

adjustable clamp
C-clamp
half-split stopper
meter stick
calculator
stand
stopwatch
cord
graph paper

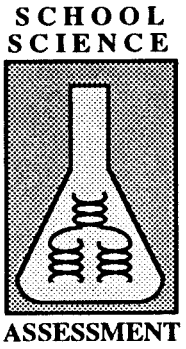
EXPERIMENT REPORT #3 - Part A

Organize your experiment under the following headings:
PROCEDURE and DATA TABLE
Use the front and back of these sheets if necessary.

PROCEDURE

EXPERIMENT REPORT #3 - Part A

DATA TABLE (For results and observations)



SCIENCE LABORATORY TEST

PHYSICS

TASK NUMBER 3
THE PENDULUM

PART B

TIME : 50 MINUTES

NAME _____ SEX _____

SCHOOL _____ DATE _____

These tests are being developed through
the University at Buffalo and NORC with support of
the National Science Foundation and
the U.S. Office of Education

LABORATORY TEST#3
The Pendulum - Part B

Introduction

You will have 50 minutes to complete this part. You have been provided with a detailed Procedure (see next page) which you are to follow. Record your work for Part B on the answer sheet under the appropriate headings.

Problem

Imagine that you are working for a company which makes grandfather clocks of all different sizes. Donald Trump wants to buy a large customized clock for the top of Trump Tower and your job is to determine how long to make the pendulum so that it will have a period of 2 seconds.

You remember from your Physics class that the length of the pendulum determines the period of the pendulum's swing. Using the equipment supplied, you will conduct an experiment which will allow you to accurately determine what length the pendulum will need to be to have a 2 second period.

a) Perform the experiment by following the steps outlined in the procedure.

b) Under the heading **RESULTS/OBSERVATIONS** record the data collected in the experiment. Use statements, descriptive paragraphs, and tables of data where appropriate.

c) Under the heading **CALCULATIONS** show all equations and calculations used.

d) Construct a **GRAPH** that shows the relationship between the variables measured.

e) Under the heading **CONCLUSION** give an interpretation of your results.

f) At the end of the 50 minutes, your answer sheets will be collected.

Materials

adjustable clamp
C-clamp
half-split stopper
meter stick
calculator
stand
stopwatch
cord
graph paper

EXPERIMENT REPORT #3 - Part B

Complete the Procedure as given on these sheets.
Record your Data in the table provided.

Procedure

1. Be certain that the adjustable clamp is securely attached to the ring-stand.
2. Check the connection of the half-split stopper between the jaws of the adjustable clamp and suspend the pendulum through the slit until it measures 0.10 m in length. Tighten the clamp.
3. Start the pendulum from approximately a 20° angle.
4. Measure the time for ten complete cycles (back **and** forth motion = a complete cycle) and record your results.
5. Repeat Steps #2 - 4, for pendulum lengths of 0.20m, 0.30m, 0.40m, 0.50m, 0.60m, 0.70m, and 0.80m.
6. Complete the Data Table by computing period (T) and period squared (T^2) for each length.
7. Plot period squared against length and be certain that the scale for length on your graph includes values from 0 to 1.2m.
8. Using your graph, determine the length of the pendulum needed for a period of 2 seconds.
9. Record your answer under Conclusion.

OBSERVATIONS/RESULTS

Length (m)	Time for 10 cycles (sec)	Period (T) (sec)	T^2 (s^2)
0.10			
0.20			
0.30			
0.40			
0.50			
0.60			
0.70			
0.80			

EXPERIMENT REPORT #3 - Part B

Record your Calculations, Graph, and Conclusion on these sheets.

CALCULATIONS

GRAPH

EXPERIMENT REPORT #3 - Part B

CONCLUSION

Based on a graphical analysis of the data you collected in this experiment, discuss your conclusion as to how long to construct a pendulum which has a period of 2 seconds. Be certain to explain how you used your data to arrive at this conclusion.

SCHOOL SCIENCE ASSESSMENT

SCIENCE LABORATORY TEST

PHYSICS

TASK NUMBER 4
SNELL'S LAW

PART A

TIME : 30 MINUTES

NAME _____ SEX _____

SCHOOL _____ DATE _____

These tests are being developed through
the University at Buffalo and NORC with support of
the National Science Foundation and
the U.S. Office of Education

LABORATORY EXPERIMENT TEST #4
Snell's Law - Part A

Introduction

This laboratory test presents a problem and lists materials available to you. Your task is to design a strategy for solving the problem. Please record all your answers on these sheets. You will have 30 minutes to plan and design an experiment to solve the problem.

Problem

One of the tests that scientists can use to identify a substance is to measure its index of refraction through the Snell's Law equation. (The index of refraction is equal to the ratio of the sine of the angle of incidence to the sine of the angle of refraction.)

$$n = \frac{\sin i}{\sin r}$$

Where: n = index of refraction
i = angle of incidence
r = angle of refraction

Suppose that you are working for the Consumer Protection Agency and your job is to determine whether the index of refraction of a sample of Corn Syrup meets Federal standards of 1.55. You have been given the data collected by a colleague, and your job is to analyze the ray diagram and determine whether the index of refraction is 1.55 (+ or - 5%).

a) Under the heading **PROCEDURE** list in order the steps of the procedure you will use to solve the problem. You may include a diagram to help illustrate your plans for the experiment. Include any safety procedures you would follow.

b) Construct a **DATA TABLE** or indicate any other method that you could use to record the observations and results that will be obtained.

c) At the end of the 30 minutes, your answer sheet for Part A will be collected.

PLEASE NOTE: In Part A, you are NOT to proceed with any part of the actual experiment. You are just to plan and organize a way to investigate the problem.

Materials

Corn Syrup A	pencil
semi-circular dish	straight pins
graph paper	cardboard
calculator	ruler
protractor	graph paper

EXPERIMENT REPORT #4 - Part A

Organize your experiment under the following headings:
PROCEDURE and DATA TABLE
Use the front and back of these sheets if necessary.

PROCEDURE

EXPERIMENT REPORT #4 - Part A

DATA TABLE (For results and observations)

SCHOOL SCIENCE ASSESSMENT

SCIENCE LABORATORY TEST

PHYSICS

TASK NUMBER 4
SNELL'S LAW

PART B

TIME : 50 MINUTES

NAME _____ SEX _____

SCHOOL _____ DATE _____

These tests are being developed through
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the U.S. Office of Education

LABORATORY TEST#4
Snell's Law - Part B

Introduction

You will have 50 minutes to complete this part. You have been provided with a detailed Procedure (see next page) which you are to follow. Record your work for Part B on the answer sheet under the appropriate headings.

Problem

One of the tests that scientists can use to identify a substance is to measure its index of refraction through the Snell's Law equation. (The index of refraction is equal to the ratio of the sine of the angle of incidence to the sine of the angle of refraction.)

$$n = \frac{\sin i}{\sin r}$$

Where: n = index of refraction
i = angle of incidence
r = angle of refraction

Suppose that you are working for the Consumer Protection Agency and your job is to determine whether the index of refraction of a sample of Corn Syrup meets Federal standards of 1.55. You have been given the data collected by a colleague, and your job is to analyze the ray diagram and determine whether the index of refraction is 1.55 (+ or - 5%).

a) Perform the experiment by following the steps outlined in the procedure.

b) Under the heading **RESULTS/OBSERVATIONS** record the data collected in the experiment. Use statements, descriptive paragraphs, and tables of data where appropriate.

c) Under the heading **CALCULATIONS** show all equations and calculations used.

d) Construct a **GRAPH** that shows the relationship between the variables measured.

e) Under the heading **CONCLUSION** give an interpretation of your results.

f) At the end of the 50 minutes, your answer sheets will be collected.

Materials

Corn Syrup A	pencil
semi-circular dish	straight pins
graph data	cardboard
calculator	ruler
protractor	graph paper

EXPERIMENT REPORT #4 - Part B

Complete the Procedure as given on these sheets.
Record your Data in the table provided.

PROCEDURE

1. The ray diagram shows the angles of incidence and refraction for Corn Syrup A when a light ray was directed at the semi-circular container.

2. Measure and record the values for the incident and refracted angles from the ray diagram.

3. Compute the values for the sine function for these angles.

4. Plot the values for sin *i* against the values for sin *r* and determine the index of refraction from the slope of the graph.

   (Recall $n = \frac{\sin i}{\sin r}$)

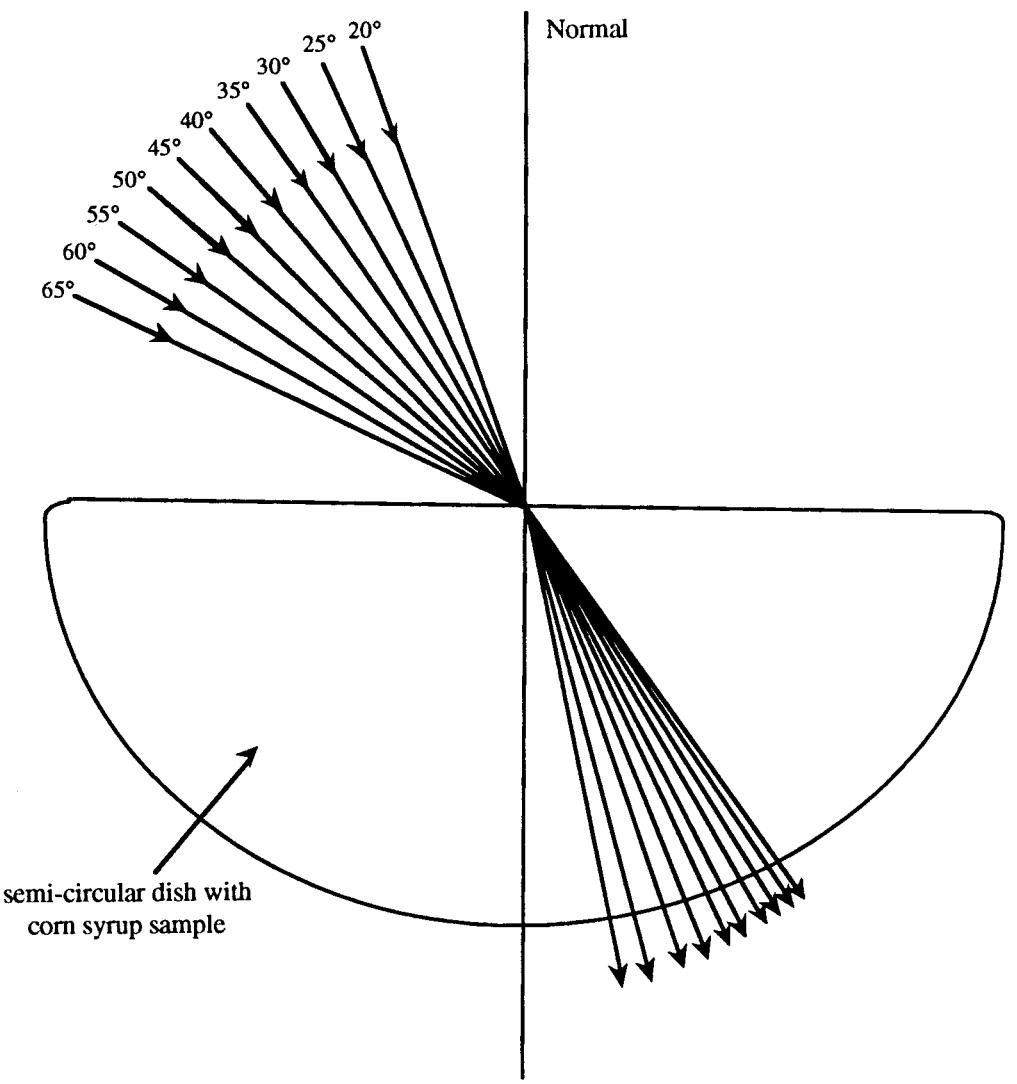
5. Determine whether the index of refraction is within the limits of:
   1.55 (+ or - 5%). Show all calculations.

6. Record your answer under Conclusion.

Data Table

Angle *i*	Sin *i*	Angle *r*	Sin *r*
20°			
25°			
30°			
35°			
40°			
45°			
50°			
55°			
65°			

EXPERIMENT REPORT #4 - Part B



Ray Diagram

EXPERIMENT REPORT #4 - Part B

Record your Calculations, Graph, and Conclusion on these sheets.

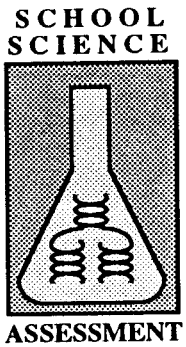
CALCULATIONS

GRAPH

EXPERIMENT REPORT #4 - Part B

CONCLUSION

Based on a graphical analysis of the data you collected in this experiment, discuss your conclusion as to whether the index of refraction of Corn Syrup A meets Federal standards of 1.55. Be certain to explain how you used your data to arrive at this conclusion.



SCIENCE LABORATORY TEST

PHYSICS

TASK NUMBER 5
ELECTRIC CIRCUITS

PART A

TIME : 30 MINUTES

NAME _____ SEX _____

SCHOOL _____ DATE _____

These tests are being developed through
the University at Buffalo and NORC with support of
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LABORATORY TEST #5
Electric Circuits - Part A

Introduction

This laboratory test presents a problem and lists materials available to you. Your task is to design a strategy for solving the problem. Please record all your answers on these sheets. You will have 30 minutes to plan and design an experiment to solve the problem.

Problem

Imagine that you are working for an electronics firm. You have been assigned the task of determining the power dissipated in the combination of two resistors connected in series to a 6 volt battery.

You will recall that:

$$P = VI = I^2R = V^2$$

Where: P = power, V = voltage, R = resistance, I = current.

a) Under the heading **PROCEDURE** list in order the steps of the procedure you will use to solve the problem. You may include a diagram to help illustrate your plans for the experiment. Include any safety procedures you would follow.

b) Construct a **DATA TABLE** or indicate any other method that you could use to record the observations and results that will be obtained.

c) At the end of the 30 minutes, your answer sheet for Part A will be collected.

PLEASE NOTE: In Part A, you are NOT to proceed with any part of the actual experiment. You are just to plan and organize a way to investigate the problem.

Materials

2 resistors of unknown resistance
10 connecting leads
6 Volt battery
ammeter
knife switch
voltmeter

EXPERIMENT REPORT #5 - Part A

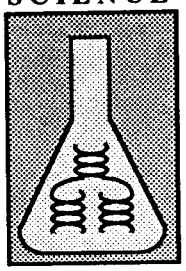
Organize your experiment under the following headings:
PROCEDURE and DATA TABLE
Use the front and back of these sheets if necessary.

PROCEDURE

EXPERIMENT REPORT #5 - Part A

DATA TABLE (For results and observations)

SCHOOL SCIENCE



ASSESSMENT

SCIENCE LABORATORY TEST

PHYSICS

TASK NUMBER 5
ELECTRIC CIRCUITS

PART B

TIME : 50 MINUTES

NAME _____ SEX _____

SCHOOL _____ DATE _____

These tests are being developed through
the University at Buffalo and NORC with support of
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the U.S. Office of Education

LABORATORY TEST#5
Electric Circuits - Part B

Introduction

You will have 50 minutes to complete this part. You have been provided with a detailed Procedure (see next page) which you are to follow. Record your work for Part B on the answer sheet under the appropriate headings.

Problem

Imagine that you are working for an electronics firm. You have been assigned the task of determining the power dissipated in the combination of two resistors connected in series to a 6 volt battery.

You will recall that:

$$P = VI = I^2R = V^2$$

Where: P = power, V = voltage, R = resistance, I = current.

a) Perform the experiment by following the steps outlined in the procedure.

b) Under the heading **RESULTS/OBSERVATIONS** record the data collected in the experiment. Use statements, descriptive paragraphs, and tables of data where appropriate.

c) Under the heading **CALCULATIONS** show all equations and calculations used.

d) Under the heading **CONCLUSION** give an interpretation of your results.

e) At the end of the 50 minutes, your answer sheets will be collected.

Materials

2 resistors of unknown resistance
10 connecting leads
6 Volt battery
ammeter
knife switch
voltmeter

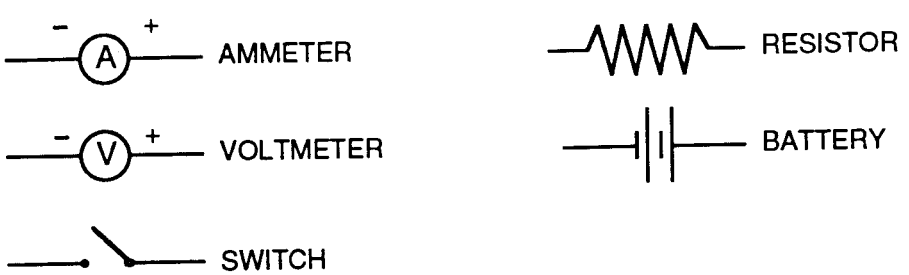


Figure 1

EXPERIMENT REPORT #5 - Part B

Complete the Procedure as given on these sheets.
Record your Data in the table provided.

PROCEDURE

1. Set up the circuit as shown in the Figure 2 below. **Do not close the switch until the evaluator checks your work sheet.**

2. Measure the current in the circuit by placing the ammeter in series with the resistors, as shown in Figure 3 below. **Do not close the switch until the evaluator checks your work sheet.** Record your measurements (magnitude and units) in the data table.

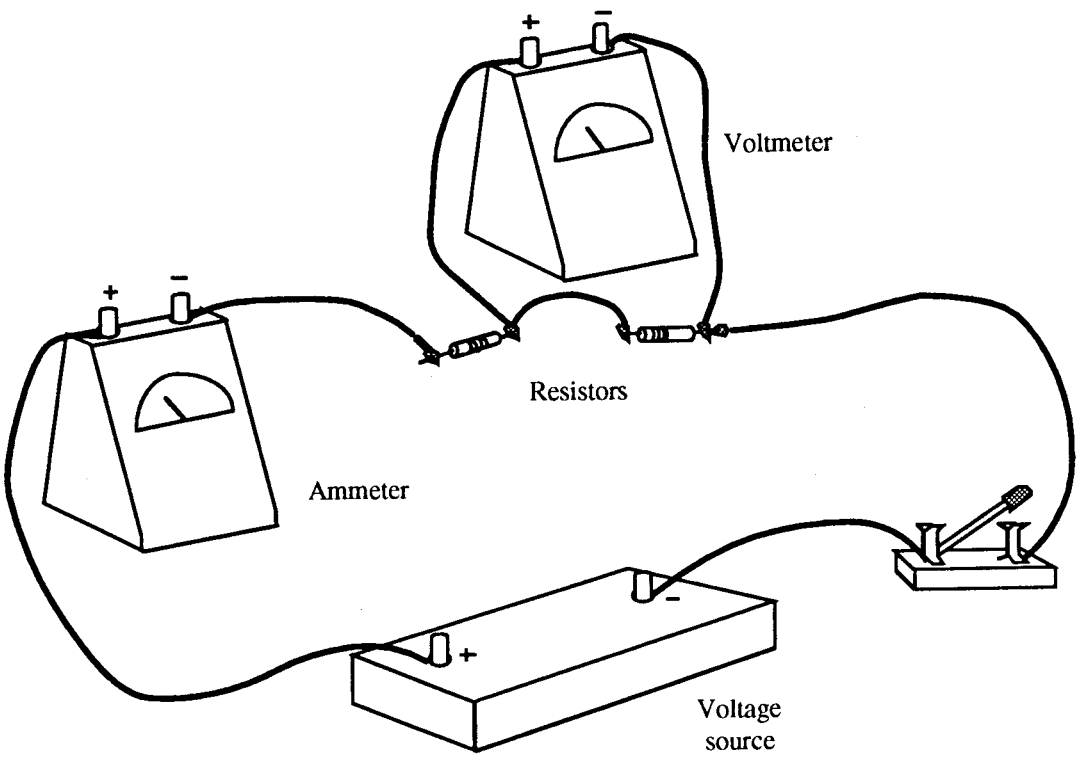


Figure 2

EXPERIMENT REPORT #5 - Part B

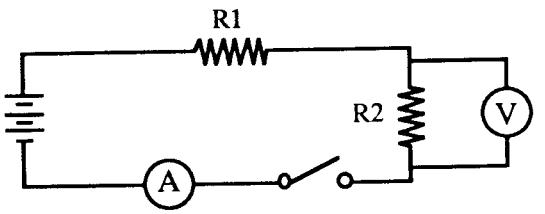


Figure 3

3. Measure the voltage drop across each resistor in the circuit by placing the voltmeter in parallel with the resistors, as shown in Figure 3 above. **Do not close the switch until the evaluator checks your work sheet.** Record your measurements (magnitude and units) in the data table.

4. Determine the total voltage in the series circuit by adding the voltage drops for each resistor.

5. Refer to the equations listed in the Problem, to compute the power used by the circuit. Show your calculations.

Data Table

Variables	Measurements
current	
voltage across one resistor	
voltage across second resistor	
total voltage in circuit	

EXPERIMENT REPORT #5 - Part B

Record your Calculations and Conclusions on these sheets.

CALCULATIONS

EXPERIMENT REPORT #5 - Part B

CONCLUSION

Based on the analysis of the data you collected in this experiment, determine the power dissipated by the two resistors connected in series. Be certain to explain how you used your data to arrive at this conclusion.

SCHOOL SCIENCE ASSESSMENT

SCIENCE LABORATORY TEST

PHYSICS

TASK NUMBER 6
MAGNETIC FIELDS

PART A

TIME : 30 MINUTES

NAME _____ SEX _____

SCHOOL _____ DATE _____

These tests are being developed through
the University at Buffalo and NORC with support of
the National Science Foundation and
the U.S. Office of Education

LABORATORY TEST#6
Magnetic Fields - Part A

Introduction

This laboratory test presents a problem and lists materials available to you. Your task is to design a strategy for solving the problem. Please record all your answers on these sheets. You will have 30 minutes to plan and design an experiment to solve the problem.

Problem

Design and implement a method to determine the
- location,
- arrangement,
- polarity of the magnet(s)

inside a sealed *mystery* box using the equipment provided.

a) Under the heading **PROCEDURE** list in order the steps of the procedure you will use to solve the problem. You may include a diagram to help illustrate your plans for the experiment. Include any safety procedures you would follow.

b) Construct a **DATA TABLE** or indicate any other method that you could use to record the observations and results that will be obtained.

c) At the end of the 30 minutes, your answer sheet for Part A will be collected.

PLEASE NOTE: In Part A, you are NOT to proceed with any part of the actual experiment. You are just to plan and organize a way to investigate the problem.

Materials

container of iron filings
paper
compass
mystery box

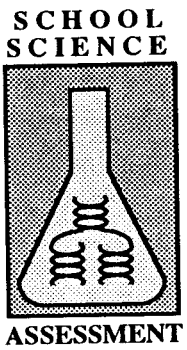
EXPERIMENT REPORT #6 - Part A

Organize your experiment under the following headings:
PROCEDURE and DATA TABLE
Use the front and back of these sheets if necessary.

PROCEDURE

EXPERIMENT REPORT #6 - Part A

DATA TABLE (For results and observations)



SCIENCE LABORATORY TEST

PHYSICS

TASK NUMBER 6
MAGNETIC FIELDS

PART B

TIME : 50 MINUTES

NAME _____ SEX _____

SCHOOL _____ DATE _____

These tests are being developed through
the University at Buffalo and NORC with support of
the National Science Foundation and
the U.S. Office of Education

LABORATORY TEST#6
Magnetic Fields - Part B

Introduction

You will have 50 minutes to complete this part. You have been provided with a detailed Procedure (see next page) which you are to follow. Record your work for Part B on the answer sheet under the appropriate headings.

Problem

Design and implement a method to determine the
- location,
- arrangement,
- polarity of the magnet(s)

inside a sealed *mystery* box using the equipment provided.

a) Perform the experiment by following the steps outlined in the procedure.

b) Under the heading **RESULTS/OBSERVATIONS** record the data collected in the experiment. Use statements, descriptive paragraphs, and tables of data where appropriate.

c) Under the heading **CONCLUSION** give an interpretation of your results.

d) At the end of the 50 minutes, your answer sheets will be collected.

Materials

container of iron filings
paper
compass
mystery box

EXPERIMENT REPORT #6 - Part B

Complete the Procedure as given on these sheets.
Record your Data in the table provided.

PROCEDURE

1. Place a sheet of white paper with the edges folded upward (about 1/2") on top of the box. Place an X on the paper over the X on the box. Draw an outline of the box on the paper.

2. Sprinkle iron filings evenly over the surface of the paper to determine the location of the magnets. Draw the location of the magnets in the OBSERVATIONS/RESULTS section. Do not draw the field lines.

3. Use the compass to determine the location and polarity of the poles of the magnet(s) inside the box. Indicate the polarities on your drawing.

4. When your drawing is complete, explain in the CONCLUSION what evidence led to your drawing of the arrangement and polarity of the magnet(s) inside the box.

EXPERIMENT REPORT #6 - Part B

OBSERVATIONS/RESULTS (Include a drawing of the mystery box and its contents)

EXPERIMENT REPORT #6 - Part B

CONCLUSION

Based on your analysis of the observations you made in this experiment, discuss your conclusion as to the placement and polarity of magnets in the mystery box. Be certain to explain how you used your observations to arrive at this conclusion.