Name _____

Date _____

LAB 1

LIGHT INTENSITY AND DISTANCE

LABORATORY DESCRIPTION

I. Background

As an object gets further from a light source the amount of light on the object decreases. This lab will explore the relationship between d, the distance from the object to the light source, and I, the intensity of the light shining on the object. Physicists have developed the law of inverse squares, which states that the intensity of the light is inversely proportional to the square of the distance from the light source. In other words, the intensity, I, for a distance, d, is given by the function $I(d) = \frac{k}{d^2}$, for some constant k. In this lab you will find the constant k and try to make some conjectures as to what factors have an effect on k.

II. Lab

Step 1. Lab stations will be set up when you arrive to class. You will use the class calculator at the station and then you may take that calculator to your seat with you to transfer the data to your calculator.

Step 2. You will see two light bulbs, one 15 watt and one 25 watt, a light bulb socket, a meter tape, a CBL with a light probe attached to a block of wood, and a calculator with the LIGHT program in its memory.

Step 3. Turn the CBL unit on by pressing the red [ON] button. Turn your calculator on and press the [PRGM] button. Use the arrow keys to scroll down to the program called LIGHT and press the [ENTER] button twice.

Step 4. Place the 25 watt light bulb into the socket and, with the bulb off, press [ENTER] to zero the probe. Choose to take a sample of 10 points.

Step 5. Turn the light bulb on. Move the probe to a position 30 cm from the light bulb. Press [ENTER] to measure the intensity.

Step 6. Move the probe 5 cm further back from the light and take a new reading by pressing [ENTER] again. Continue in this manner until all of the sample points have been taken.

Step 7. You should now have a plot (graph) of data on your calculator. The distance in centimeters is represented on the x-axis scale and the light intensity in milliwatts per square centimeter (mW/cm^2) is represented on the y-axis scale.

Step 8. Disconnect the class calculator from the CBL unit. Return to your seat to transfer the data to your calculators. After making the transfers be sure to return the class calculator to your lab station. See the separate instruction sheet for transferring the data to your calculator if you have a TI-83.

III. Analysis of Data

Use the trace feature on your calculator to make a table of the points.

$d(cm)$	$I(d)(mW / cm^2)$	Estimate for k
30		
35		
40		
45		
50		
55		
60		
65		
70		
75		

Using your data and the equation $I(d) = \frac{k}{d^2}$, fill in the table above.

Theoretically, the value for k is the same for each distance d (this is what we mean when we say k is a constant). However, the lack of precision of the measurements and the calibration of the probe will result in varying estimates. Making use of all of your estimates, determine what you think is a reasonable value for k. What is your value for k? How did you determine it?

Enter the function determined by your constant k in Y_1 and graph it on your calculator. Does the graph match the data closely? If not, you may want to reconsider your choice of k.

Use your function to estimate the intensity of light at a distance of 105 cm.

Use your function to estimate the distance (in cm) at which the intensity will be .5 mW/cm^2.

Repeat steps 4 through 8 with the other light bulb. What is your estimate for k for this light bulb?

What would you guess might affect the constant k?

LIGHT INTENSITY AND DISTANCE LABORATORY REPORT

Your laboratory report should be typed and should include the following:

- a description of the overall situation being modeled
- a description of the procedure you followed in collecting the data
- the tables of the data obtained by the CBL
- sketches of the graphs of the data obtained by the CBL
- details of the method used to obtain the constant, k, and your final equation I as a function of distance d
- predictions, using your function, of the intensity of light at distances greater than or less than those measured by the CBL

The "audience" for your report should be a student who has used a graphing calculator, but not a CBL and who has never considered modeling this type of behavior with a mathematical function. The report should be approximately two to three pages long.

Although the basic report should be typed, you may write mathematics symbols and the data or sketch graphs in longhand. Be sure to read the criteria that will be used in evaluating your paper (next page).

The report is due at the beginning of class on _____

LAB 1 — LIGHT INTENSITY AND DISTANCE EVALUATION

Name: _____

IDEAS/CONTENT OF SPECIFIC ASSIGNMENT

	WEAK	STRONG
Procedure for collecting data	_____	
Table of data obtained by the CBL	_____	
Sketch of the graph of data obtained by the CBL, including six labeled data points	_____	
Method and details of finding the function	_____	
Predictions of intensity of light at distances beyond those measured by the CBL	_____	

STYLE/ORGANIZATION

Unique/individual introduction that captures the reader's attention	_____	
Interesting presentation	_____	

CONVENTIONS

Generally free of grammatical errors	_____	
Generally free of spelling and punctuation mistakes	_____	

Comments: