INVERSE-SQUARE LAW FOR LIGHT

INTRODUCTION:

A light source will appear brighter (more intense) to a nearby observer into a more distant observer. If the intensity (brightness) can be measured at a known distance, then we can compute the intensity at any other distance. For example, since we can measure the intensity of sunlight on the Earth, we can compute the intensity of sunlight on each of the other planets. Of course, we also need to know the distance of each planet from the sun.

PROCEDURE:

1. A photocell and a computer will be used to measure the intensity of light at various distances from a small bulb. Your instructor will do this. Record the data in the table below. The sensor measures in units of lux, which are proportional to the flux at the sensor location.

Distance	Measured intensity	Measured-background	Computed intensity
10 cm	3096 lux		
20	884		
30	442		
40	280		
50	167		
70	143		
100	108		
Background (reading with no direct light)	71		x

Subtract the background from the measured intensity to fill in column 3 in the table above.

Question 1. Describe qualitatively how the light intensity varied with the distance of the photocell from light bulb.

2.a. When the photocell was 50 cm from lightbulb, the light intensity (measured-background (column 3)) was _________lux. Substitute these values for the intensity and distance into the equation below and solve it for the constant. This constant is characteristic of the source of light—primarily it is proportional to the total power the source is emitting. Other light sources would have different constants.

Intensity = Constant x [1/Distance^2]

Constant = _________

b. Use your value of the constant to compute the values of the intensity for each of the measured distances used in the table above. Add your computed intensity values to the table. Include a sample calculation below:

c. Plot a graph of intensity (vertical axis) vs. distance (horizontal axis) using your computed intensity values. Choose scale values to fill as much of the graph paper as possible with your graphs. Plot each of these points using this symbol: ∇. Connect the points with a smooth curve.
d. Plot on the same graph the measured intensities, using this symbol $\oplus$ for each point (don't join these with lines).

Question 2. How closely do the measured points agree with your computed curve? Are they closer in one region than in another? Why might this occur?

Question 3. Neptune is 30 times farther from the sun than the Earth. Compare quantitatively the intensity of sunlight at Neptune with the intensity on Earth. (Hint: Let the intensity of sunlight on the earth equal 1.0).

Question 4. Compare quantitatively the intensity of sunlight at the orbit of Venus with the intensity on earth.

Question 5. What would happen if a semi transparent material were placed between light bulb and the photocell? Test your prediction using the set up at the front of the room and record your result.

Question 6. A star that actually emits a great amount of light may appear to us to be rather dim. What are two reasons why this could occur?