

Quiz #3—Solutions
Mathematics 302—Chaos Theory
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Directions: Carefully answer the questions below. Remember that your goal is to convince me that you know what is going on, so show your work! When relevant, round your final answers to 3 decimal places.

The intensity, I , of light at a given location is inversely proportional to the square of the distance, d , from that location to the light source.

1. Write the form of the mathematical model for this situation.

Answer: $I = k \cdot \frac{1}{d^2}$.

2. List the factors which cannot affect the value of the proportionality constant if the model is to remain valid.

Answer: The values of I and d cannot affect the value of k if the model is to remain valid.

3. List *two factors* which do affect the value of the proportionality constant.

Answer: Anything other than d which affects the intensity of the light will affect k , such as: the intensity of the light at its source, the presence of particulate matter in the air, the humidity in the air, etc.

4. From your list above, determine the conditions under which the model will remain valid.

Answer: The model will remain valid unless: (1) the proportionality constant depends on d , or (2) the factors affecting k – the intensity of the light at its source, the level of particulate matter in the air, the humidity of the air, etc. – changes. In that case, we would need to recalibrate the model by recomputing the value of k .

5. The intensity of a light for various distances is shown in the table below. Do they indicate the model is valid and, if so, determine the proportionality constant.

Answer: To determine this, then for each data pair, we compute $k = I \cdot d^2$ to obtain about 4.76 each time. Since the value of k is constant, it appears that the model is valid and the value of $k = 4.76$.

d in m	0.1	0.5	0.75	2.0
I in $\frac{W}{m^2}$	476.03	19.11	8.46	1.19