

MATH 1311

Chapter 4 Wrap Up

Radiation Exposure

According to the United States Environmental Protection Agency concerning radiation exposure decreases by a factor of 4 as distance doubles.

Meaning that as your distance from a radiation source doubles, your radiation exposure will be $\frac{1}{4}$ of the previous amount.

Assume your radiation exposure 1 mile from a nuclear event is measured at 400 rems.

Use this information to fill out the following table:

Distance (in miles)	Exposure (in rems)
1	400
2	
4	

Use this table of data to create an exponential model of the radiation exposure.

- Plot the scatter plot of this model.
- Plot the graph of the exponential curve.
- How accurate is this model to the data we have?

Using this model:

- What was the initial radiation exposure of this event?
- What will the exposure be at a distance of 10 miles?
- What will the exposure be at a distance of 50 miles?

Rewrite this a logarithmic function:

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$$y = 800 (0.41017)^x$$

$$(y/800) = (0.41017)^x$$

$$\log_{0.41017} (y/800) = x$$

Change of base formula:

To change a base within a logarithm: apply the following formula:

$$\log_n a = \frac{\log_b a}{\log_b n}$$

You can pick whatever b-value you want, typically e or 10 since those evaluate the easiest.

Write our function as a base e logarithm

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$$\log_{0.41017} (y/800) = x$$

$$\frac{\ln \frac{y}{800}}{\ln 0.41017} = x$$

$$\frac{\ln \frac{y}{800}}{-0.89118} = x$$

Convert back into exponential notation:

$$\frac{\ln \frac{y}{800}}{-0.89118} = x$$

$$\ln (y/800) = -0.89118x$$

$$y/800 = e^{-0.89118x}$$

$$y = 800e^{-0.89118x}$$

Graph this new function:

What do you notice?

Why did we convert into logarithms just to convert back to exponents?

Radiation Exposure Effects

Acute Radiation Exposure	
Effects of Large, Whole-Body Radiation Doses	
Effect	Dose (rems)
No observable effect	0-25
Slight blood changes	25-100
Significant reduction in blood platelets and white blood cells (temporary)	100-200
Severe blood damage, nausea, hair loss, hemorrhage, death in many cases	200-500
Death in less than two months for over 80%	>600

Based on your exponential curve, how far do you need to be to experience only slight blood changes?

How far must you be to experience no permanent injury?

Nave, CR. (2014). Hyperphysics. Georgia State University.
<http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html>