

② ~~The~~ The brightness of light decreases exponentially.
 After 500 ft, light from a lighthouse is $\frac{1}{2}$ as bright as on shore. How far away will it be $\frac{1}{8}$ as bright?

Let $B(d)$ = Brightness of light at a distance d away.

~~area~~ Then

$$B(d) = B_0 \left(\frac{1}{2}\right)^{d/500}$$

We need to solve $B(d) = \frac{1}{8} B_0$ so solve for d :

$$B_0 \left(\frac{1}{2}\right)^{d/500} = \frac{1}{8} B_0$$

$$\frac{d}{500} \log\left(\frac{1}{2}\right) = \log\left(\frac{1}{8}\right)$$

$$d = 500 \frac{\log\left(\frac{1}{8}\right)}{\log\left(\frac{1}{2}\right)}$$

After 500 ft light is $\frac{1}{2}$ as bright, so
 after 1000 ft light is $\frac{1}{4}$ as bright and
 after 1500 ft light is $\frac{1}{8}$ as bright

so $d = 1500$ ft.

Are these the same answers? Again, yes!

Awesome!

$$500 \frac{\log\left(\frac{1}{8}\right)}{\log\left(\frac{1}{2}\right)} = 500 \frac{\log\left(\left(\frac{1}{2}\right)^3\right)}{\log\left(\frac{1}{2}\right)} = 3 \cdot 500 \frac{\log\left(\frac{1}{2}\right)}{\log\left(\frac{1}{2}\right)} = 1500$$