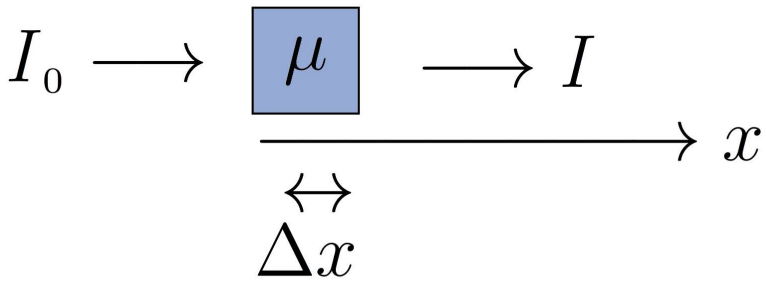
1.3.2 Quiz: Making Sense of the Lambert-Beer Model

Bookmark this page

Here's the Lambert-Beer model Margo presented:



View Larger Image
Image Description

μ uniform attenuation coefficient (units cm^1)

I_0 input x-ray intensity (units kVp)

I output x-ray intensity (units kVp)

Δx length of object (units cm)

$$I = I_0 e^{-\mu \Delta x}$$

Units of the Lambert Beer Model

- The units of intensity are **peak kilovoltage**, kVp, which is the maximum voltage applied across an X-ray tube.

- The units of Δx, the thickness, are centimeters, or cm.

- What are the units of μ, the attenuation coefficient? They are determined by the other units. Because $I = I_0 e^{-\mu \Delta x}$ must have units kVp, and I_0 has units kVp as well, this means we want this means we want $e^{-\mu \Delta x}$ to be unitless. So the units of μ must cancel those of Δx, and hence the units of μ are 1/cm or cm^{-1}.

Question 1

1/1 point (graded)

From the Lambert-Beer model, we know that the intensity of an x-ray of initial intensity I_0 passing through an object with attenuation coefficient μ and length Δx is given by

$$I = I_0 e^{-\mu \Delta x}$$

Compare the resulting intensities of light when a x-ray with initial intensity I_0 passes through each of the following objects.

Choose all that are correct.

Attenutation and Thickness Combinations

A: $\mu = 0.5, \Delta x = 1$

B: $\mu = 0.5, \Delta x = 2$

C: $\mu = 1, \Delta x = 2$

D: $\mu = 2, \Delta x = 0.5$

E: $\mu = 3, \Delta x = 3$

- [ ] E results in the largest output intensity
- [x] A results in the largest output intensity ✔
- [ ] Output intensity for C > Output intensity for B

- [x] Output intensity for B is the same as the Output intensity for D. ✔
- [ ] None of the above.

✔

Explanation
The intensity is determined by the product of the thickness and attenuation coefficient. Because $f(t) = e^{-t}$ is always decreasing, smaller values of $t = \mu \cdot \Delta x$ correspond to larger values of I. The value of $\mu \cdot \Delta x$ is smallest in A and equal for B and C.

Submit You have used 1 of 3 attempts

Answers are displayed within the problem

Question 2

1/1 point (graded)
Margo explained that attenuation depends on both the material (measured by the attenuation coefficient μ) and the thickness of the material. According to the Lambert-Beer model, do objects that attenuate more light (because of material or thickness or both) result in lesser output intensity? (Why or why not?)

- (•) Yes, always. ✔
- ( ) Sometimes, but not always.
- ( ) Never.

Submit You have used 1 of 1 attempt

✔ Correct (1/1 point)

Learn About Verified Certificates

© All Rights Reserved

English ▼

© 2012–2018 edX Inc. All rights reserved except where noted. EdX, Open edX and the edX and Open edX logos are registered trademarks or trademarks of edX Inc. | 粵ICP备17044299号-2

POWERED BY OPENedX

Download on the App Store

ANDROID APP ON Google play