Physics 290 – Winter 2004

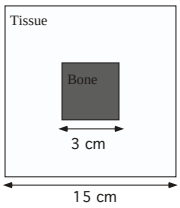
Assignement 3

Due January 29, 2004

1. Find the wavelength and frequency of photons of the following energy:
   a.) 50 keV x-rays
   b.) 0.511 MeV gamma rays

2.Find the attenuation of 50 keV, monoenergetic x-rays in the following thicknesses of material (see table at the bottom of the page):
   a.) 3 cm of typical bone.
   b.) 20 cm of air $\frac{I}{I_0} = 1.00$
   c.) 20 cm of soft tissue (or water)
   d.) 3 cm of bone immersed in 20 cm of tissue
   e.) 1 cm of lead

3. The x-ray attenuation coefficients (μ) for muscle ($\rho \approx 1$ gm/cm^3) and bone ($\rho = 1.9$ gm/cm^3) at 50 keV and 70 keV are given below. Sketch the x-ray image and find the bone/tissue contrast for the upper leg model **for each energy** shown below. This is a cross section of the leg.



X-rays are incident from the left onto a film plate at the right.

Contrast is related to the ratio of the difference between the maximum and minimum silver density of the exposed film by $C = \frac{O_{max}}{O_{min}}$.

Material	μ (50 keV)	μ (70 keV)	ρ
Air (N_2)	0.03 cm^2/gm		1.2×10^{-3} gm/cm^3
Water	0.21 cm^2/gm		1 gm/cm^3
Muscle	0.20 cm^2/gm	0.18 cm^2/gm	1 gm/cm^3
Fat	0.17 cm^2/gm		0.9 gm/cm^3
Bone	0.30 cm^2/gm	0.20 cm^2/gm	1.9 gm/cm^3
Pb	6 cm^2/gm		11.3 gm/cm^3