Homework #6

1. The effective half-life of a radiopharmaceutical in the organ of interest is 2 hours. If the biological half-life is 3 hours, then what is the physical half-life of the radionuclide used to label the pharmaceutical?

$$T_{eff\,1/2} = 2 \quad hour$$

$$T_{b1/2} = 3 \quad hour$$

$$\frac{1}{T_{eff\,1/2}} = \frac{1}{T_{b1/2}} + \frac{1}{T_{p1/2}}$$

$$\frac{1}{2} = \frac{1}{3} + \frac{1}{T_{p1/2}}$$

$$T_{p1/2} = 6 \quad hour$$

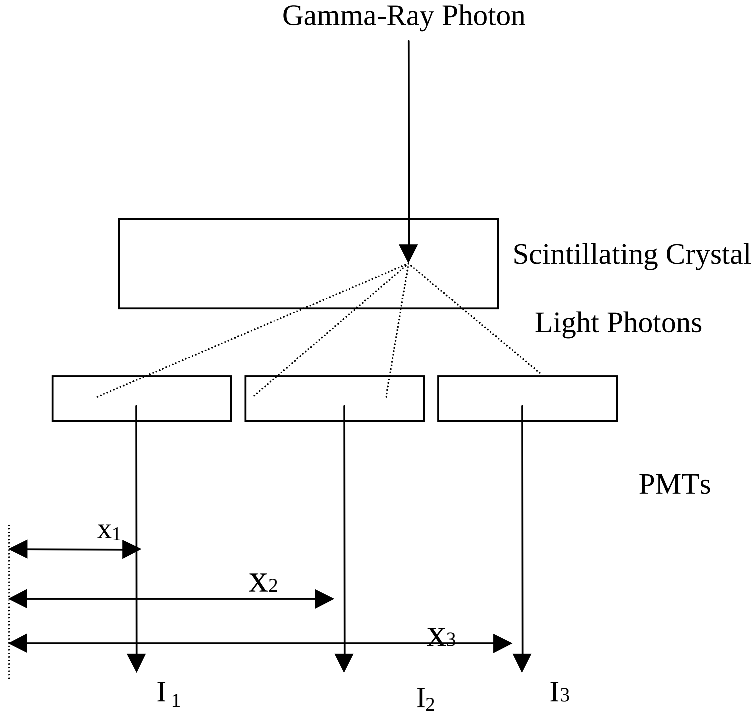
2. In nuclear medicine imaging, (a) What advantage do higher energy isotopes have? (b) What disadvantage do they have?

Solution:

(a) less attenuation through the body

(b) less photons will be stopped by the crystal -- less sensitivity (less quantum efficiency at the same dose injected to patient)

3. A Gamma camera is built with a scintillation crystal and three PMTs, as shown in the following diagram. When a gamma ray photon excites the scintillation crystal, the amplitude of the voltage pulse produced by any of the PMT tube is given in the following table. Please using centroid calculation formula to estimates the most likely position, within the crystal, of the gamma ray interaction.



Locationn of PMTs	PMT output
X1 = 1cm	100 mV
X2 = 5cm	1000 mV
X3 = 10cm	500 mV

Solution:

$$X = \frac{I_1X_1 + I_2X_2 + I_3X_3}{I_1 + I_2 + I_3}$$
$$= \frac{1\times 100 + 5\times 1000 + 10\times 500}{100 + 1000 + 500}$$
$$= 6.3125cm$$