Homework #7
For practice, not to be handed in.

1. Consider a x-ray system with a planar source distribution, $s(r) = \exp(-ar^2)$ and a recording plane a distance d form the source with impulse response, $h(r) = \exp(-br^2)$. Determine at what distance z_0 that a transparency object $t(x,y)$ should be placed so as to maximize the relative response at a spatial frequency ρ_0 in the transparency. Discuss the optimal distance z_0 when $a \gg b$ and $b \gg a$. Neglect all obliquity factors.

2. Consider the object below with a small lesion of thickness w. Let $(\mu_2-\mu_1)w \ll 1$.
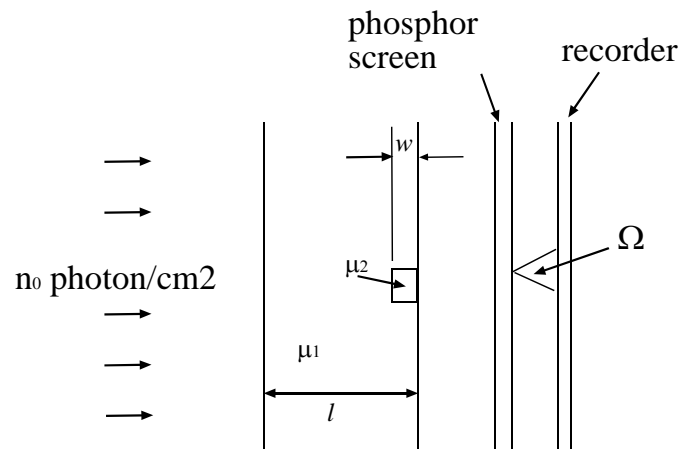
    a. Calculate the CNR of the x-ray photons emerging from the object where the size of a resolution element is A cm^2.
    b. Calculate the CNR of the recording where the phosphor screen has a capture efficiency η and produces L light photons per x-ray photon, and R events per light photon are emitted. Also consider that only light photons contained in a solid angle Ω strike the detector.