1. A boundary region between carbon and aluminum media is traversed by a fluence of $4.10 \times 10^{11}$ electrons/cm$^2$ with energy of 12.5 MeV. Ignoring delta rays and scattering, what is the absorbed dose $D_c$ in the carbon adjacent to the boundary, and what is the dose ratio $D_{Al}/D_c$, given the collisional stopping power of 12.5 MeV electrons in C and Al is 1.769 MeV cm$^2$/g and 1.658 MeV cm$^2$/g respectively?

2. A small air-filled cavity has copper walls with thickness equal to the maximum electron range. The cavity volume is 0.100 cm$^3$, the air density is 0.001293 g/cm$^3$, and a given gamma ray exposure generates a charge (either sign) of $7.00 \times 10^{-10}$ C.

   a) What is the average absorbed dose in the cavity air?

   b) Apply Bragg-Gray theory to estimate the absorbed dose in the adjacent copper wall assuming a mean energy of 0.45 MeV for the cavity-crossing electrons, given the collision stopping power of 0.45 MeV electrons in air and Cu is 1.845 MeV cm$^2$/g and 1.402 MeV cm$^2$/g respectively?

   c) Suppose the mean electron energy is in error by 34% and should have been 0.65 MeV. Redo part (b). What is the resulting percentage error in $D_{Cu}$, given the collision stopping power of 0.65 MeV electrons in air and Cu is 1.725 MeV cm$^2$/g and 1.312 MeV cm$^2$/g respectively?

3. Estimate the linear accelerator beam current necessary to deliver a photon dose rate of 500 cGy/min at a depth of 10 cm in a water phantom.

   To solve this problem, you will have to make a series of assumptions and approximations. Explicitly identify the assumptions and approximations you are making.