

22.01 Introduction to Ionizing Radiation
Fall 2003
Problem Set # 9

Due Date: Friday, November 21, 2003

1. You have decided that exposure to natural background radiation is good for you. List 8 ways you could increase your exposure. Rank each in order of decreasing magnitude of dose (1 = highest dose, 8 = lowest dose).
2. What does the “binary” nature of BNCT offer in the treatment of certain brain tumors that most conventional types of therapy (including surgery) do not?
3. Both ^{10}B and ^{157}Gd are under investigation for neutron capture therapy. The thermal neutron capture reaction in ^{157}Gd leads to ^{158}Gd , which de-excites by emitting prompt gamma rays and conversion electrons. The Q value for this reaction is 7.9 MeV. The thermal neutron capture cross section for ^{157}Gd is 255,000 barns (one of the highest cross sections known). The Q value for the ^{157}Gd reaction is higher and the cross section is larger. Why is ^{10}B (thermal neutron capture cross section = 3840 barns) a better choice than ^{157}Gd for neutron capture therapy?
4. Describe the process by which Joseph Kehayias detects carbon in the human body. Include the generation of the neutrons, the energy of the neutrons, the nuclear reaction involved, the signal from the carbon that is detected.