Problem 1

Compute the atomic densities of ^{235}U, ^{238}U, and O in UO_2 when its density is 10.41 g/cm^3 and the uranium is enriched to 5 wt% in ^{235}U.

Problem 2

Free neutrons undergo β^- decay with a half-life of 10.4 minutes. Determine the probability that a neutron will decay before being absorbed in an infinite absorbing material (assume no scattering). Estimate this probability for a thermal neutron ($v = 2200$ m/s) in water.

Problem 3

Consider a 1000 MWE reactor with a 33% efficiency conversion from MWT to MWE. What is the minimum volume of UO_2, enriched to 3 (atom) % ^{235}U that could theoretically supply the yearly energy production of this reactor. Treat energy contributions as coming only from the fission of ^{235}U. These fission events release about 200 MeV with 95% of that energy staying in the reactor.

Problem 4

Given UO_2 with 2.5×10^{21} atoms/cm^3 of ^{235}U and 2.0×10^{22} atoms/cm^3 of ^{238}U, find the partial densities of ^{235}U, ^{238}U, and O, and determine the enrichment.