Team Exercises #4

Problem 1

A reactor contains 5% (by atom) enriched uranium dioxide, which is 15% of the entire core by volume.

a) Calculate the macroscopic cross section for this core if we were to treat it as a homogeneous volume.

b) If the reactor were a cube with a side length of 4 m and a beam of 10^{15} thermal neutrons were incident on one face of the cube, how many neutrons would we expect to make it through to the other side?

Nucleus	Thermal σ_t (b)	Mass (g/mol)
^{1}H	20.8	1.008
^{16}O	3.5	15.995
^{235}U	607.5	235.044
^{238}U	11.8	238.050

Compound	$\rho\left(\mathrm{g/cm^3}\right)$
H_2O	1.0
UO_2	10.4

Problem 2

A neutron beam with an intensity of 2×10^{12} neutrons/(cm^2·s) is incident on an unknown shielding material and has a beam spot of 5 cm^2. The shielding material has a thickness of 10 cm.

a) On average, 3.0×10^9 neutrons/s make it through the shield uncollided. What is the macroscopic cross section of the shield material?

b) What is the mean free path of a neutron in the shielding material?

c) If a single beam pulse is 10 μs, how many collisions are expected to take place in the shielding material?