

**Nuclear Engineering 150 – Discussion Section**  
**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 $\sigma_t$ (b)	Mass (g/mol)
$^1\text{H}$	20.8	1.008
$^{16}\text{O}$	3.5	15.995
$^{235}\text{U}$	607.5	235.044
$^{238}\text{U}$	11.8	238.050
Compound	$\rho \left( \text{g/cm}^3 \right)$	
$\text{H}_2\text{O}$	1.0	
$\text{UO}_2$	10.4	

## Problem 2

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

- a) On average,  $3.0 \times 10^9$  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  $\mu$ s, how many collisions are expected to take place in the shielding material?