22.106 Neutron Interactions and Applications
(Spring 2005)

Problem Set No. 4 **Due: April 7, 2005**

Problem 1

Write down the Neutron Transport Equation defining all the terms in the equation. Derive the streaming term in the Transport equation.

Problem 2

Derive the escape probability $P(E' \rightarrow E)$. Discuss how you would calculate this quantity using MCNP. Discuss the conditions under which you would or would not expect the MCNP calculation to agree with a numerical evaluation of your analytical expression.

Problem 3

Consider one-dimensional neutron transport in a purely scattering medium where the cross section $\sigma(x)$ is a known function of position. Apply the same kind of argument used for Problem 2 to derive an expression for the probability $P(x' \rightarrow x)$ that a neutron will go the distance from x' to x without scattering, where x > x' but otherwise both are arbitrary. Discuss your result as compared to $P(E' \rightarrow E)$

Problem 4

Define the variable lethargy u and show that the average increase in lethargy per collision is given by

$$\xi = 1 + \frac{\alpha l\ell n\alpha}{1-\alpha} \sim 2/A \quad \text{for A >>1}$$

where $\alpha = \left[(A-1)^2/(A+1)^2\right]$. Discuss how ξ can be used to estimate the collision density in a medium where A > 1.