1. (10 points) Briefly describe what each term in the Transport Equation [Eqn. (1)] physically represents.

a. streaming loss rate – the rate at which particles exit outside the boundaries of the volume

b. total interaction loss rate – the rate of particles lost due to absorption

c. in scattering source rate – the rate of scattering into *E,* Ω from all other energies and directions

d. fission source rate – the rate of neutrons produced by fissions in the system

2. (10 points) List three assumptions needed to get from the Transport Equation to the

Diffusion Equation.

a. The angular flux depends only weakly on direction (represented by omega with a circumflex)

b. ∑s is azimuthally symmetric, meaning it only depends on the angle of the scattering cosine μ

c. Scattering is at most linearly anisotropic, and angular flux is at most linearly anisotropic as well

3. (5 points) List four locations where the Diffusion Equation is not valid because the

underlying assumptions do not hold; for each explain why the assumptions do not hold

in that location.

a. near a void – this is because the transport equation becomes a hyperbolic wave function in a void, altering the equation to a degree that makes it unusable

b. near a boundary – the boundary neutron reflection distorts the actual volume of neutrons near the boundary region

c. near a neutron source – this is because there are far too many neutrons produced in the region, and so the equation cannot model cannot account for the large production, distorting the equation

d. near a strong absorber – this is because the absorber distorts the equation by eliminating neutrons from the system

4. (a) (6 points) Write the steady state, 2-D diffusion equation and explain how we

typically characterize it from the viewpoint of labeling second order linear PDEs

(and provide the characterization). Assume D is not a function of x or y for this

part.



This is characterized as a second-order, elliptical PDE.

(b) (4 points) Can you think of any physical cases in which this characterization would

change? Describe at least two cases and the change causing the characterization

change.

In a void, the e quation will become a hyperbolic PDE. If the scattering is forward-peaked, it will become a parabolic PDE.

5. (10 points) At what energy is the lowest isolated resonance of 235U, 238U, 239Pu, and

240Pu? Why do we care about that?

U-235: 2.85\*10^-1 eV

U-238: 6.5 eV

Pu-239: 2.97\*10^-1 eV

Pu-240: 1.04 eV

We can about these because this will influence at what energy we want neutrons to be released into the system at. Given that we now know where the resonance regions start for various elements, we can code bins discretizing various neutron energies (since capturing the entirety of the resonance region is extremely difficult and time-consuming, we have a starting point for where the resonance region begins and approximate from there). Resonance-region neutrons are also important for the four-factor formula to maintain criticality.

6. (a) (1 point) How has the course structure worked for you so far? How could it be

improved?

It is good, but a lot of information to manage for someone with practically zero programming background.

(b) (1 point) How comfortable do you feel with Monte Carlo transport and using MCNP

to solve problems. What would have made this module more effective?

Honestly not very. I conceptually understand Monte Carlo transport but I just require more practice with it and MCNP to use them to solve problems. I feel both could be their own courses (and probably are at the undergraduate level in some places).

(c) (1 point) Do you feel that I adequately addressed the first round of feedback from

PF5? If not, how can I improve?

Yes