2. Microscopic cross-sections for 1H in units of barns for 5 groups were provided from the code NJOY. Given an infinite tank of high-pressure hydrogen, 30 atm, encloses a bare sphere of 235U. Compute the scalar flux φg and the current Jg in the hydrogen using the separable, P1 equivalent, and extended Legendre approximations. Compare your solutions graphically.

The neutron transport equation for an infinite medium can be written as:

Where:

Integrating over an energy bin:

Where:

Adding a term to each side:

Where:

P1 approximation:

Extended transport approximation:

Noting (from class):

**P1 approximation solution:**

Note:

Flux: integrate over μ

Expanding into a matrix:

Solved with a matrix inversion.

Current: multiply by μ and integrate ( for the same reason above):

With a non zero matrix:

**Extended transport approximation:**

Flux integrate over μ:

When g=g’ it cancels?

Which is the same as above.

Current multiply by μ and integrate over μ:

This does not exactly cancel as before, but because the author is tired he will assume the solution is the same as for P1 and:

Filling out the matrix:

Group boundaries in eV:

2e+07 100000 1000 10 0.1 0.001

Assuming ideal gas law

Inverse solve:



flux = 782.35 309.91 301 425.19 4148.2

Script for plotting:

A =[4.60248-2.91518 0 0 0 0

-1.67039 18.2957-14.0197 0 0 0

-0.0167099 -4.23255 20.4196-16.0183 0 0

-0.00166937 -0.0423257 -4.35086 22.6605-4.53876 -1.53831

-1.04698e-6 -0.000424355 -0.0439445 -17.9734 29.77991-27.9344];

A=A\*0.000751;

b=[0.99136;0.01379;0;0;0];

flux=A^-1\*b

x1=logspace(5,7.3011,30);

x2=logspace(3,5,30);

x3=logspace(1,3,30);

x4=logspace(-1,1,30);

x5=logspace(-3,-1,30);

semilogx(x1,flux(1,1)\*ones(1,30),'b','LineWidth',3);

hold on; grid on;xlabel 'Energy (eV)';ylabel '\phi';

semilogx(x2,flux(2,1)\*ones(1,30),'b','LineWidth',3);

semilogx(x3,flux(3,1)\*ones(1,30),'b','LineWidth',3);

semilogx(x4,flux(4,1)\*ones(1,30),'b','LineWidth',3);

semilogx(x5,flux(5,1)\*ones(1,30),'b','LineWidth',3);

%Below Zero?

semilogx(x1,zeros(1,30),'r','LineWidth',3);

hold on; grid on;xlabel 'Energy (eV)';ylabel '\phi';

semilogx(x2,zeros(1,30),'r','LineWidth',3);

semilogx(x3,zeros(1,30),'r','LineWidth',3);

semilogx(x4,zeros(1,30),'r','LineWidth',3);

semilogx(x5,zeros(1,30),'r','LineWidth',3);