

[Diffusion Parameters]  
 (Chapter 1.8.2 in *Elements*)

Thermal neutron diffusion parameters of various materials at 300 K for average speed  $\langle v \rangle = 2480$  m/s. (See Beckurts and Wirtz 1964, Table 6.1.1; and *Reactor Physics Constants*, ANL-5800 1963, Table 3.17.)

Material	$\rho$ , gm/cm <sup>3</sup>	D, cm	$D_o = \langle v \rangle D$ , 10 <sup>5</sup> cm <sup>2</sup> /s	$\Sigma_{abs,(\langle v \rangle)}$ , 10 <sup>-2</sup> cm	L, cm
H <sub>2</sub> O	1.0	0.144	0.357	1.89	2.755
CH <sub>2</sub>	0.92	0.107	0.265	2.24	2.19
D <sub>2</sub> O (pure)	1.1	0.810	2.01	0.0031	161.
D <sub>2</sub> O (99.8 mol%)	1.1	0.802	1.99	0.007	107.
Be (pure)	1.85	0.495	1.23	0.11	21.2
Graphite (pure)	1.6	0.858	2.13	0.0311	52.5

The diffusion properties are temperature dependent. Room temperature values are well known for materials relevant to nuclear reactor applications. They are somewhat difficult to measure. For materials and at temperatures relevant to cold neutron moderators, diffusion data are rare and are the objects of major, one-at-a-time calculations from fundamental physics models of cold moderator materials. (Beckurts and Wirtz 1964, ANL-5800 1963).

**Exercise**

Basing analysis on the Laplacian for cylindrical geometry, work out the expression for spatial eigenfunctions (Bessel functions in the radial direction), spatial eigenfunctions and time eigenvalues for a moderator of right circular form.