19.23 (a) The units of D_T are

$$D_T = \frac{k\,(\text{J/s-m-K})}{\rho(\text{kg/m}^3)\,c_p(\text{J/kg-K})} = \text{m}^2/\text{s}$$

(b) The values of D_T for the several materials are given below. (Note: values for k and c_p are taken from Table 19.1; density values are from Table B.1, Appendix B, and converted to units of kilograms per meter cubed):

For copper

$$D_T = \frac{k}{\rho c_p} = \frac{398\ \text{W/m-K}}{(8.94\ \text{x}\ 10^3\,\text{kg/m}^3)(386\ \text{J/kg-K})} = 1.15\ \text{x}\ 10^{-4}\ \text{m}^2/\text{s}$$

For brass

$$D_T = \frac{120\ \text{W/m-K}}{(8.53\ \text{x}\ 10^3\ \text{kg/m}^3)(375\ \text{J/kg-K})} = 3.75\ \text{x}\ 10^{-5}\ \text{m}^2/\text{s}$$

For magnesia

$$D_T = \frac{37.7\ \text{W/m-K}}{(3.58\ \text{x}\ 10^3\ \text{kg/m}^3)(940\ \text{J/kg-K})} = 1.12\ \text{x}\ 10^{-5}\ \text{m}^2/\text{s}$$

For fused silica

$$D_T = \frac{1.4\ \text{W/m-K}}{(2.2\ \text{x}\ 10^3\ \text{kg/m}^3)(740\ \text{J/kg-K})} = 8.6\ \text{x}\ 10^{-7}\ \text{m}^2/\text{s}$$

For polystyrene

$$D_T = \frac{0.13\ \text{W/m-K}}{(1.05\ \text{x}\ 10^3\ \text{kg/m}^3)(1170\ \text{J/kg-K})} = 1.06\ \text{x}\ 10^{-7}\ \text{m}^2/\text{s}$$

For polypropylene

$$D_T = \frac{0.12\ \text{W/m-K}}{(0.91\ \text{x}\ 10^3\ \text{kg/m}^3)(1925\ \text{J/kg-K})} = 6.9\ \text{x}\ 10^{-8}\ \text{m}^2/\text{s}$$