19.23 (a) The units of D_T are

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

(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

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

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