12.39 We are asked for the critical crack tip radius for a glass. From Equation 8.1

$$\sigma_m = 2\sigma_0\left(\frac{a}{\rho_t}\right)^{1/2}$$

Fracture will occur when σ_m reaches the fracture strength of the material, which is given as $E/10$; thus

$$\frac{E}{10} = 2\sigma_0\left(\frac{a}{\rho_t}\right)^{1/2}$$

Or, solving for ρ_t

$$\rho_t = \frac{400\ a\sigma_0^2}{E^2}$$

From Table 12.5, E = 69 GPa, and thus,

$$\rho_t = \frac{(400)\left(1\ \text{x}\ 10^{-2}\ \text{mm}\right)(70\ \text{MPa})^2}{\left(69\ \text{x}\ 10^3\ \text{MPa}\right)^2}$$

$$= 4.1\ \text{x}\ 10^{-6}\ \text{mm} = 4.1\ \text{nm}$$