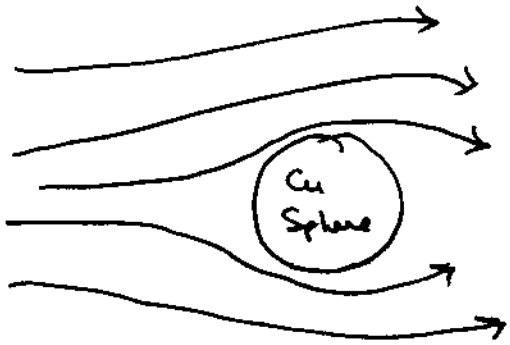
Problem 5.6 Lumped Capacitance



$T_i = 66°C$
$T_1 = 58°C$
$T_\infty = 27°C$

$t_1 = 69s$

$\theta_i = 39$
$\theta_1 = 28$

$$\frac{\theta}{\theta_i} = \exp\left[-\frac{hA_s}{\rho C_p V} t\right]$$

Cu
$\rho = 8933 \ kg/m^3$
$C_p = 385 \ J/kg\,K$

$$\ln\frac{\theta}{\theta_i} = -\frac{hA_s}{\rho C_p V} t$$

$$h = -\frac{\ln\frac{\theta_1}{\theta_i} \cdot \rho C_p V}{A_s t_1}$$

$A_s = 4\pi r^2$
$A_s = 5.067 \times 10^{-4} \ m^2$

$V = \frac{4}{3}\pi r^3$

$V = 1.0725 \times 10^{-6} \ m^3$

$h = 34.9 \ W/m^2K$

Calculate Biot Number

$$Bi = \frac{hL_c}{k} = 1.84 \times 10^{-4}$$

∴ assumption was reasonable