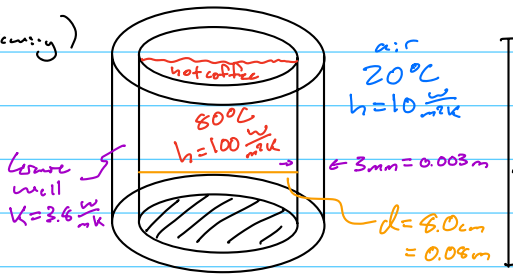
Trevor Swan **ECHE225: QUIZ #11 // 11.21.24**

Drawing)




$A_{inner\ wall} = \pi d h = \pi(0.08m)(0.12m) = 0.0302\ m^2$

$A_{outer\ wall} = \pi d h = \pi(0.08m + 2(0.003)_m)(0.12m) = 0.0324\ m^2$

1. Find $\dot{Q} = \frac{\Delta T}{R_{tot}}$

$R_{coffee} = \frac{1}{hA_s} = \frac{1}{100\frac{W}{m^2K}(.0302m^2)} = 0.331\frac{K}{W}$

radius = $\frac{d}{2}$

rad. ratio: $\frac{r_1}{r_2} = \frac{\frac{d_1}{2}}{\frac{d_2}{2}} = \frac{d_1}{d_2}$

$R_{cyl} = \frac{\ln\left(\frac{r_2}{r_1}\right)}{2\pi h k} = \frac{\ln\left(\frac{d_2}{d_1}\right)}{2\pi h k} = \frac{\ln\left(\frac{0.08m+2(.003m)}{0.08m}\right)}{2\pi(0.12m)3.8\frac{W}{mK}} = 0.0252\frac{K}{W}$

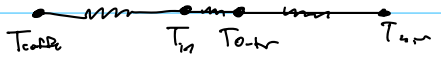
$R_{air} = \frac{1}{hA_s} = \frac{1}{10\frac{W}{m^2K}(.0324m^2)} = 3.086\frac{K}{W}$

$R_{tot} = R_{coffee} + R_{cyl} + R_{air} = 0.331 + 0.0252 + 3.086 = 3.4422\frac{K}{W}$

$\dot{Q} = \frac{80-20\ K}{3.4422\frac{K}{W}} = \boxed{17.43\ W}$

2. Find $\dot{q} = \frac{\dot{Q}}{A_s} = \frac{17.43W}{0.0324m^2} = 537.96\frac{W}{m^2}$ $\boxed{q = 537.96\frac{W}{m^2}}$

3. Find $T_{outer}$




$\dot{Q} = \frac{T_{coffee} - T_{outer}}{R_{coffee} + R_{cyl}}$

$T_{coffee} - T_{outer} = \dot{Q}(R_{coffee} + R_{cyl})$

$T_{outer} = T_{coffee} - \dot{Q}(R_{coffee} + R_{cyl})$

$T_{outer} = 80°C - 17.43W(0.331\frac{K}{W} + 0.0252\frac{K}{W})$

$= 80°C - 6.209\ K$

$\boxed{T_{outer} = 73.791\ °C}$