AE 331 MIDTERM

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2350015

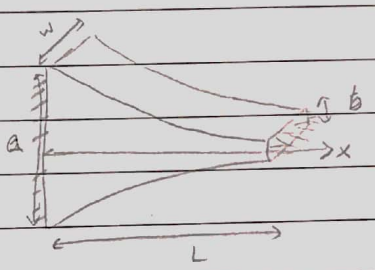
I affirm that all the work done on this exam is my own; have obeyed the rules and not given or received any aid during this exam. I understand that any indication of violation of this honor code may result to a zero-grade on this exam and to a disciplinary action.

2350015 BILAL HASSAN 14/12/2020

$a = 1, \quad b = 5$

Q1. $T(x=0) = 315K$, $T(x=L) = 515K$, $k = 215$ W/mK, $L = 15$ m

thickness $= 2y = (b-a)\left(\frac{x}{L}\right)^2 + a$



$$q_x = -kA\frac{dT}{dx}$$

$$A = b(b-a)\left(\frac{x}{L}\right)^2 + a$$

$$A = 5(4)\left(\frac{x}{15}\right)^2 + 1$$

$$q_x = -215\left(\frac{20}{225}x^2 + 1\right)\frac{dT}{dx}$$

$$\int_0^x \frac{q_x\,dx}{\frac{20}{225}x^2 + 1} = \int_{T_0}^{T} -215\,dT$$

$\rightarrow T(x=0) = 315K.$

$$q_x \times 3\sqrt{5}\tan^{-1}\left(\frac{2x}{3\sqrt{5}}\right) = 215\cdot(T_0 - T)$$

$$T(x) = -3\sqrt{5}\tan^{-1}\left(\frac{2x}{3\sqrt{5}}\right)\frac{q_x}{430} + T_0$$

$T(0) = 315\,K = T_0$

$T(15) = 515\,K \rightarrow$

$$-3\sqrt{5}\tan^{-1}\left(\frac{30}{3\sqrt{5}}\right)\frac{q_x}{430} + 315 = 515$$

$$-1.2074\,q_x = 200$$

$$q_x = -165.65\,W \rightarrow \text{Const.}$$

$$T(x) = -8.099 \tan^{-1}\left(\frac{2x}{3\sqrt{5}}\right) + 315$$

$$430$$

(b) $q_x = (-)165.65$ W as calculated in part (a)