

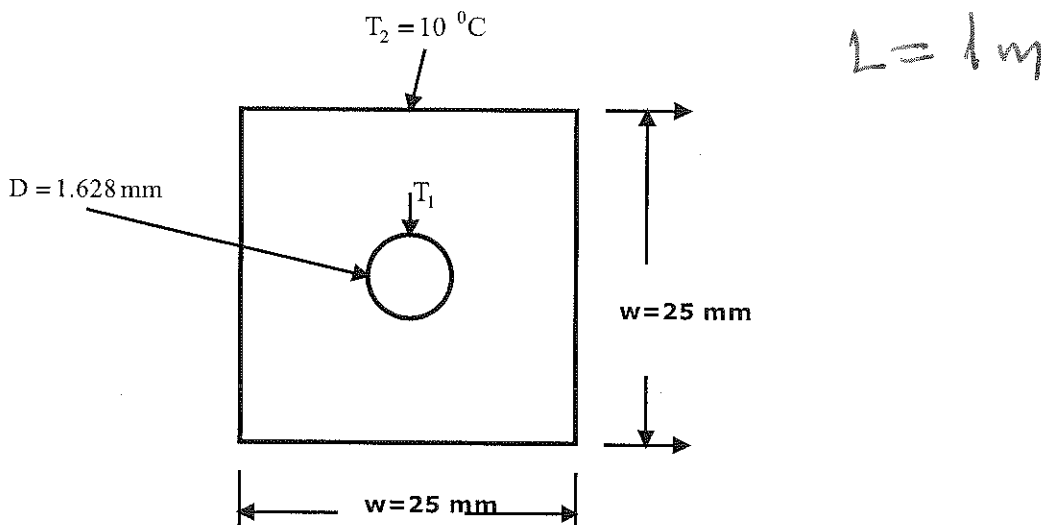
1

CANKAYA UNIVERSITY
FACULTY OF ENGINEERING AND ARCHITECTURE
MECHANICAL ENGINEERING DEPARTMENT

ME 313 Heat Transfer
Quiz 4

FALL 2018

A long 14-gage nichrome wire ($D=1.628$ mm) is encased within the center of a long porcelain rod ($k=2.2$ W/m.K) of square cross section measuring 25 mm \times 25 mm. The wire carries a steady current of $I=30$ A (Ampere), and the resistance of the wire is 50 Ω /m (Ohm / meter). If the



all outside surface of the porcelain rod is maintained at $T_2 = 10$ °C, what is the wire temperature T_1 ? . State all your pertinent assumptions related to the problem.

- 1- steady two dimensional conduction
- 2- neglect contact resistance between wire and porcelain
- 3- constant surface temperature
- 4- steady current flow
- 5- constant properties

$k = 2.2$ W/mK porcelain

$$Q = P \quad P = \text{Power}$$

$$P = I^2 R$$

$$Q = I^2 R = (30A)^2 (0.54 \Omega)$$

$$S = \frac{2\pi L}{\ln(1.08W/D)}$$

$$= \frac{2\pi (1m)}{\ln\left[\frac{1.08(0.025m)}{1.028 \times 10^{-3}m}\right]} = 2.237m$$

$$Q = kS(T_1 - T_2)$$

$$T_1 = \frac{Q}{SK} + T_2 = \frac{486W}{(2.237m)(2.2 \frac{W}{mK})} + 10^\circ C$$

$$= 109^\circ C$$