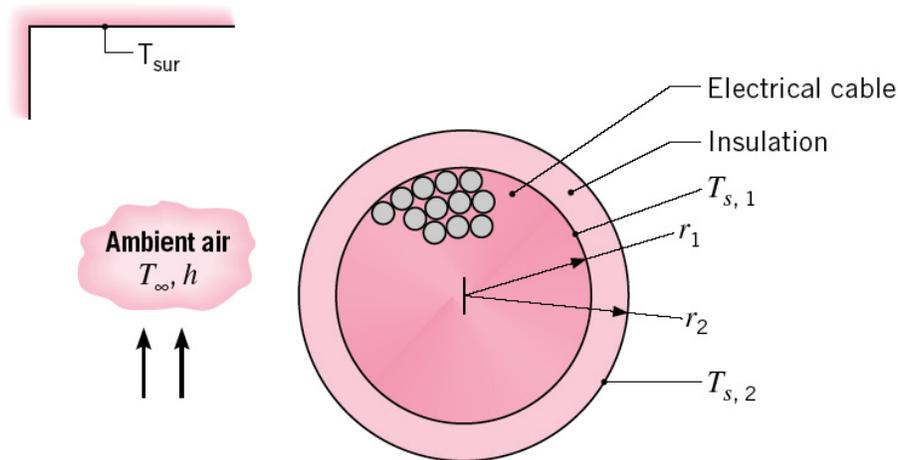


Name: _____

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- c) A square hamburger patty is cooked on a grill. The temperature of the grill is maintained at 250°C , and the top and four sides of the patty are exposed to air at 30°C . The convection heat transfer coefficients on the top and sides of the patty are $25 \text{ W/m}^2\cdot\text{K}$ and $15 \text{ W/m}^2\cdot\text{K}$, respectively. If the initial temperature of the patty is 20°C , determine the time required for the entire hamburger patty to reach a temperature of at least 70°C .

- d) Determine the steady-state temperature distributions within the electrical cable and insulating layer shown in the following figure. Assume that thermal energy is generated in the electrical cable at a rate of $q''' \text{ W/m}^3$.



Name: _____

ID #: _____

Question 2

An electric heater with a total surface area of 0.25 m^2 and a surface emissivity of 0.75 is placed in a room where the air temperature is 20°C and the walls are at a temperature of 10°C . When the heater consumes 500 W of electric power, the surface of the heater remains at a temperature of 120°C . Determine the surface temperature of the heater when it is supplied with 700 W of electric power.

Name: _____

ID #: _____

Question 3

Stainless steel nails (AISI 304) are driven through a solid wall, consisting of two layers of plywood, each 2.5 cm thick. If the total cross-sectional area of the nails is 0.5% of the cross-sectional area of the wall, determine the rate of heat transfer through this wall, if the temperature difference across the wall is 25°C. Assume that the thermal contact resistance between the two layers of plywood is 0.005 m²·K/W.

Name: _____

ID #: _____

Question 4

Heat is transferred from water to air through a brass wall ($k = 54 \text{ W/m}\cdot\text{K}$). An engineer is considering adding rectangular brass fins, 0.08 cm thick and 2.5 cm long, spaced 1.25 cm apart to the brass wall to increase the rate of heat transfer. The convection heat transfer coefficient on the water side of the wall is $170 \text{ W/m}^2\cdot\text{K}$ and the convection heat transfer coefficient on the air side is $17 \text{ W/m}^2\cdot\text{K}$.

Which side of the brass wall should the fins be added to? If the fins are added to this side of the wall, what will be the percentage increase in heat transfer compared to the same wall without fins, assuming that the temperature drop through the brass wall is negligible?

Name: _____

ID #: _____

Question 5

A large copper plate, 2.54 cm thick, is placed between two air streams. The convection heat transfer coefficient on the left hand side of the plate is $28 \text{ W/m}^2\cdot\text{K}$ and $57 \text{ W/m}^2\cdot\text{K}$ on the right hand side of the plate. If the temperature of both air streams is suddenly changed from 38°C to 93°C , determine how long it will take for the temperature of the left surface of the copper plate to reach 82°C .