SUMMARY OF CONDUCTIVE HEAT TRANSFER

The conductive heat transfer is determined by the collision of the microscopic particles within the material. This means that two objects with different temperatures that are in contact will exchange heat: from the hotter to the colder one:

Q_{in} (Rate of transfer into the wall) – Q_{out} (Rate of tranfer out of the wall) = (dE)/(dT) (Rate of change of energy of the wall) ,
where (dE)/(dT)=0 for steady operations

The Fourier's law of heat conduction says that:
Q^{dot} = kA(dT)/(dx),
where k is Thermal conductivity of the material
A is the area of the surface that transfers heat
dT is the temperature difference
dx is the thickness of the wall

but (dT)/(dx) is constant if there is a steady condition
Q^{dot}=kA (ΔT)/(L) (W),
where L is the thickness of the wall.

This can be compared to the electric current: the thermal resistance is analogous to the electric resistance:
$Q^{dot} = kA\ (T_1\text{-}T_2)/L = (T_1\text{-}T_2)/R$
where R = L/kA

EXERCISE

L = 0.4m A = 20m^2 DeltaT = 25 k = 0.78 W/mK

<u>SIMPLE METHOD</u>

Q^{dot} = kA(ΔT)/(L) = (0.78) (20) (25/0.4) = 975 W

<u>RESISTANCE CONCEPT METHOD</u>

R = L/kA = (0.4) / (0.78)(20) = 0,0256 °C/W
$Q^{dot} = (T_1\text{-}T_2)$ / R = (25) / (0,0256) = 975 W