



Kitchen Gadgets

Solution:

First, we need to convert all US Imperial units into their respective SI units. From inches to centimeters is a multiplication of 2.54. Careful though, the base unit is meters – so it is really multiplying by 0.0254. Therefore...

$$L = \left(0.0254 \left[\frac{m}{in}\right]\right) (0.125 [in]) = 0.003175 [m]$$

$$Radius = r = \left(0.0254 \left[\frac{m}{in}\right]\right) (5 [in]) = 0.127[m]$$

Next, we need the surface area that the heat flows through, which is the circular bottom of the pan. We use the equation for the area of a circle with the radius we converted to meters.

$$A = \pi r^2 = \pi(0.127)^2$$

Finally, we can look up the thermal conductivity of cast iron to find it is 52 Watts per meter-Kelvin (W/m K). Therefore, we use the heat transfer rate equation to get our result:

$$\dot{Q} = \left(52 \left[\frac{W}{mK}\right]\right) (\pi(0.127)^2 [m^2]) \frac{1 [K]}{(0.003175 [m])} = 8.3 \times 10^2 [W] = 830 W$$