Ch 9.6 - Introduction to Radial Heat Flow

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## Topics

1) What is radial flow?

2) Fourier's Law for Radial Heat Conduction

Radial Flow

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[![cross sectional areas of a plane wall, cylinder, and sphere](crossections.png)](https://www.youtube.com/watch?v=yoP3KKU912M )

## Cross Sectional Areas (3D $\rightarrow$ 2D)

Plane Wall (\*x\*) $\rightarrow$ Rectangle

Cylinder (\*r\*) $\rightarrow$ Area of the outside of a cylinder (Rectangle)

Sphere (\*r\*) $\rightarrow$ Area of a sphere

How do these areas change as we increase \*x\* or \*r\*?

Fourier's Law for Radial Heat Conduction

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## Main Ideas:

1) Heat spreading out as it moves

2) $J(r)$ is the heat flux at some radius $r$ away from the center

3) Rate of flow of heat:

$$\begin{Bmatrix}

\mathrm{rate\, of} \\

\mathrm{flow\, of} \\

\mathrm{heat} \\

\end{Bmatrix}

\begin{matrix}

\mathrm{} \\

\mathrm{=} \\

\mathrm{} \\

\end{matrix}

\begin{matrix}

\mathrm{} \\

\mathrm{J(r)A(r),} \\

\mathrm{} \\

\end{matrix}$$

where $A(r)$ is the cross-sectional area at the given radius $r$.

Fourier's Law for Radial Heat Conduction (Continuted)

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### Fourier's Law of Heat Conduction

$$

J(x) = -k\frac{dU(x)}{dx}

$$

### Fourier's Law for Radial Heat Conduction

$$

J(r) = -k\frac{dU(r)}{dr}

$$

#### Terms

$J(r)$ is the heat flux at $r$ (Watts)

$U(r)$ is the temperature at $r$ ($&deg$ C, $&deg$ F, K)

$k$ is the conductivity

Heat flux is directly proportional to temperature gradient (heat flows from \*hot\* to \*cold\*)