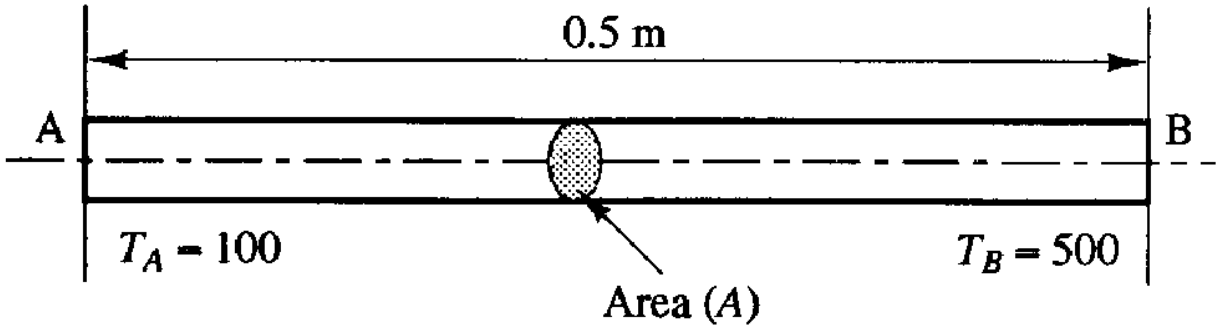
4.3 Worked examples: 1-D steady state diffusion

$$\frac{d}{dx}\left(k\frac{dT}{dx}\right)+S=0 \qquad (4.12)$$

Example 4.1 : Source-free heat conduction in an insulated rod



K = 1000 W/m·K
A=10x10^{-3} m^2

Fig 4.3

$$\frac{d}{dx}\left(k\frac{dT}{dx}\right)=0 \qquad (4.13)$$

Steady state temperature distribution?

4.3 Worked examples: 1-D steady state diffusion

Example 4.2 : 1-D Steady Conduction with heat source

L = 2 cm, q = 1000 kW/m^3

$$\frac{d}{dx}\left(k\frac{dT}{dx}\right)+q=0 \qquad (4.25)$$

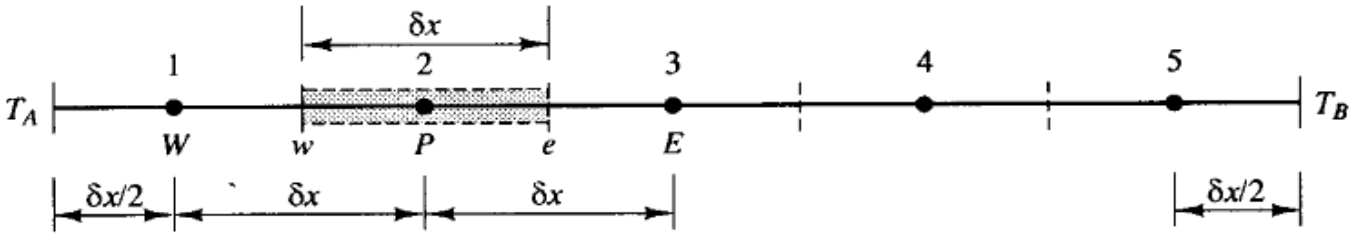


Fig 4.3

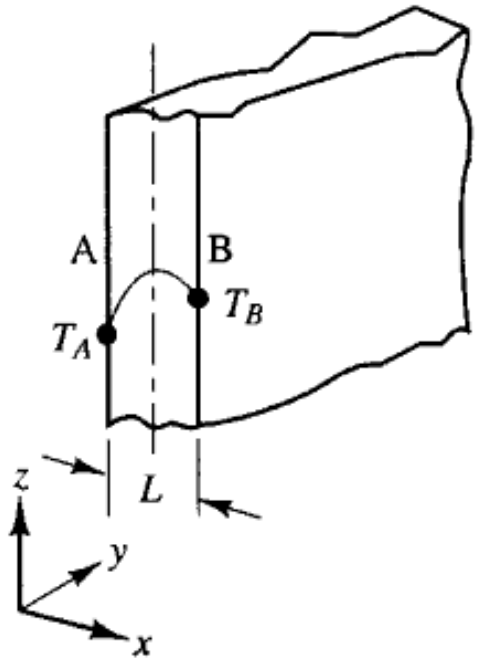


Fig 4.6

$$\int_{\Delta V}\frac{d}{dx}\left(k\frac{dT}{dx}\right)dV+\int_{\Delta V}qdV=0 \qquad (4.26)$$

$$\left[\left(kA\frac{dT}{dx}\right)_e-\left(kA\frac{dT}{dx}\right)_w\right]+q\Delta V=0 \qquad (4.27)$$

4.3 Worked examples: 1-D steady state diffusion

Example 4.3: Cooling of a circular fin by means of convective heat transfer along its length

$$\frac{d}{dx}\left(kA\frac{dT}{dx}\right)-hP(T-T_\infty)=0 \qquad (4.40)$$

$$\frac{T-T_\infty}{T_B-T_\infty}=\frac{\cosh\left[n(L-x)\right]}{\cosh(nL)} \qquad (4.41)$$

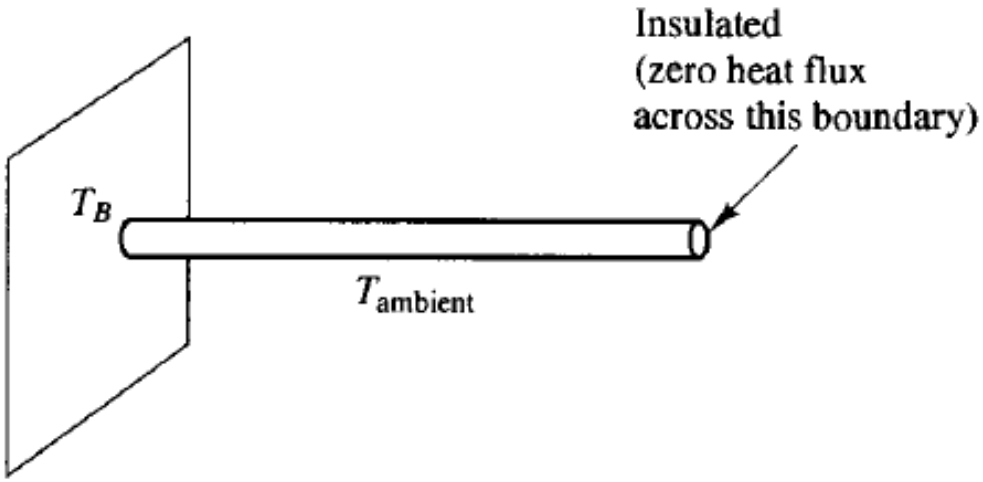


Fig. 4.9