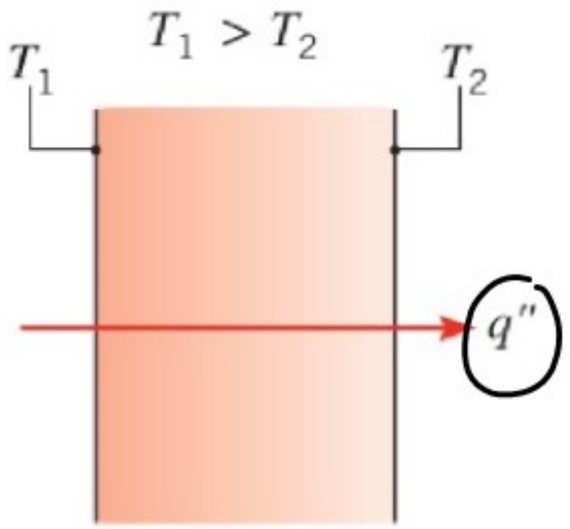
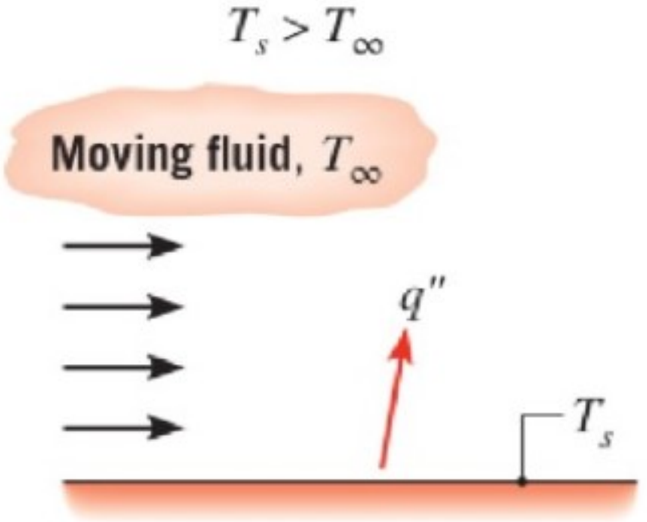
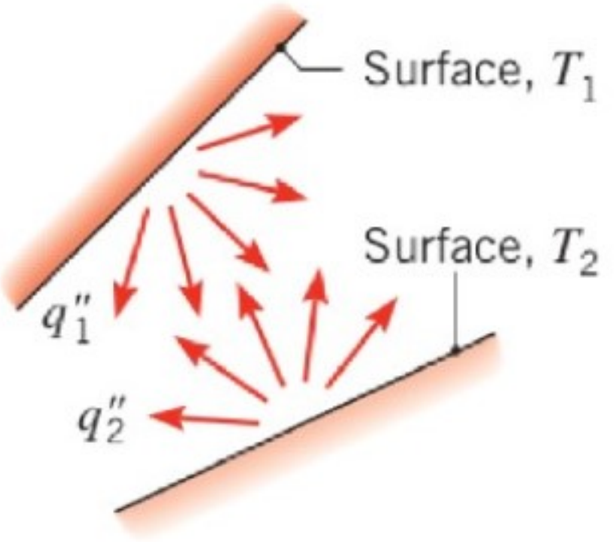
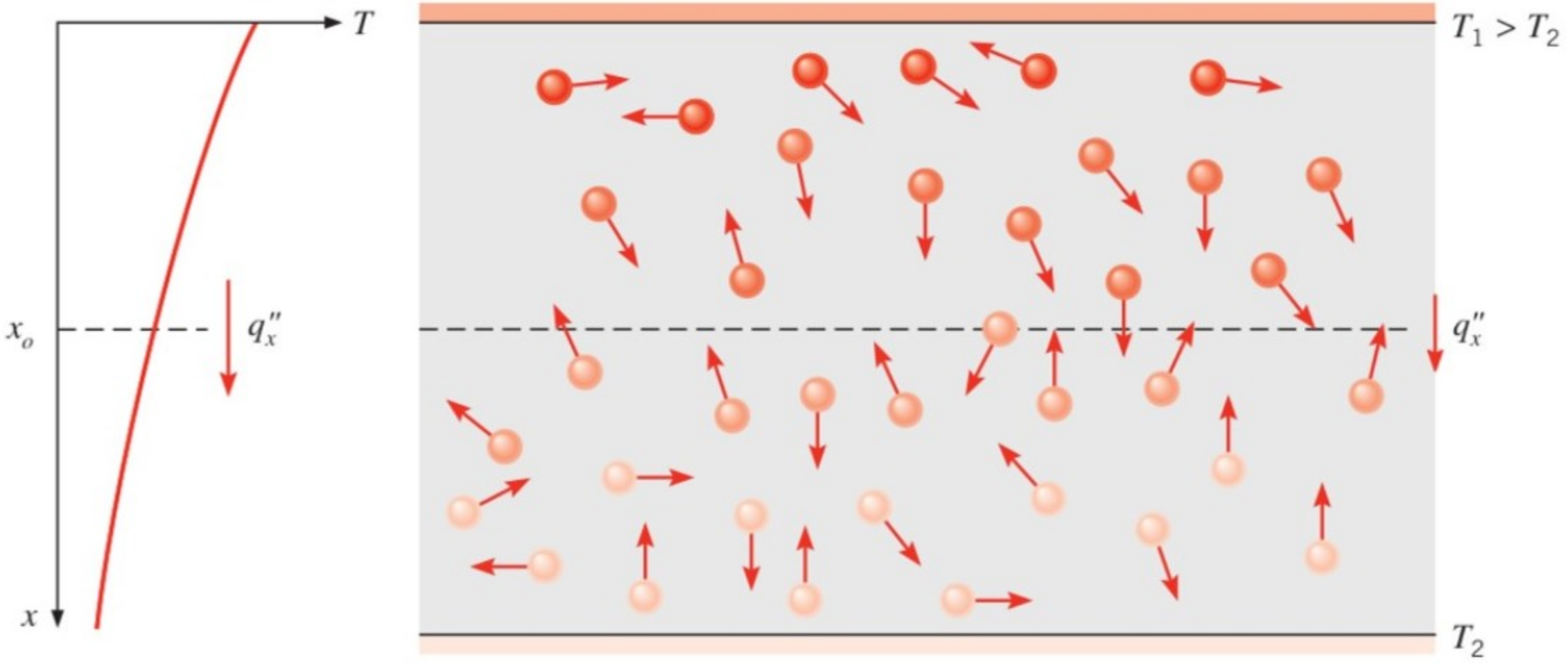
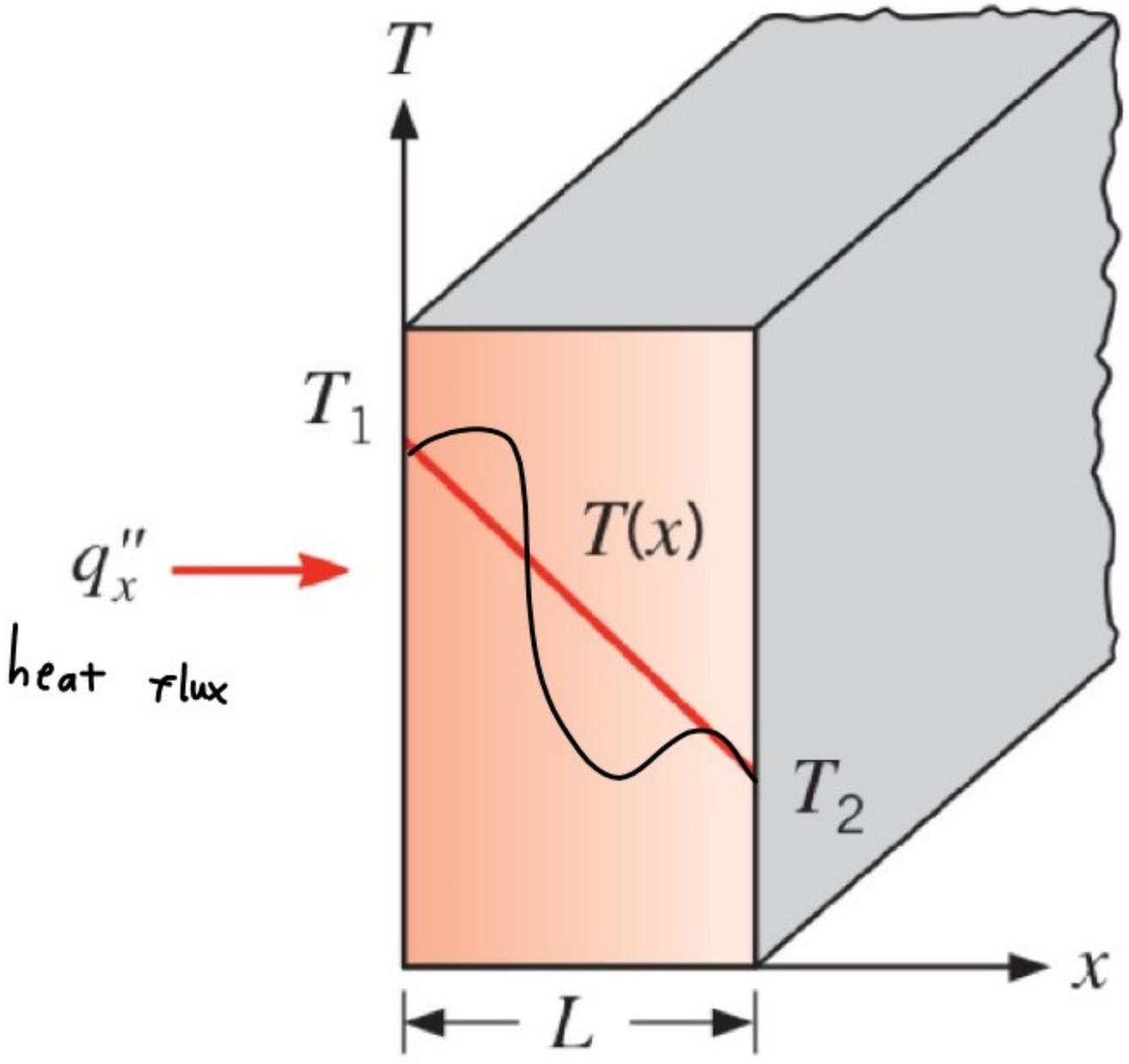
What is heat transfer

heat is energy
motion of energy

Conduction through a solid or a stationary fluid	Convection from a surface to a moving fluid	Net radiation heat exchange between two surfaces
		

Conduction





$$q''_x = -k \frac{dT}{dx}$$

k thermal conductivity

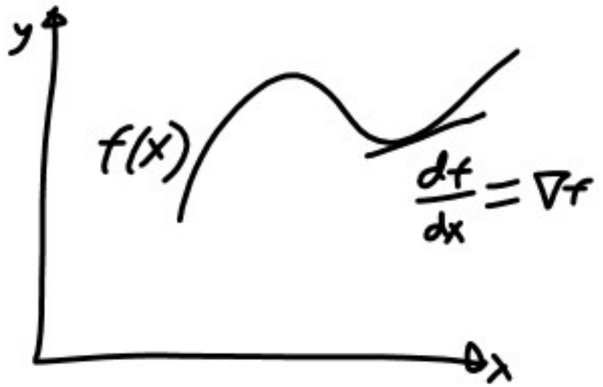
T temperature

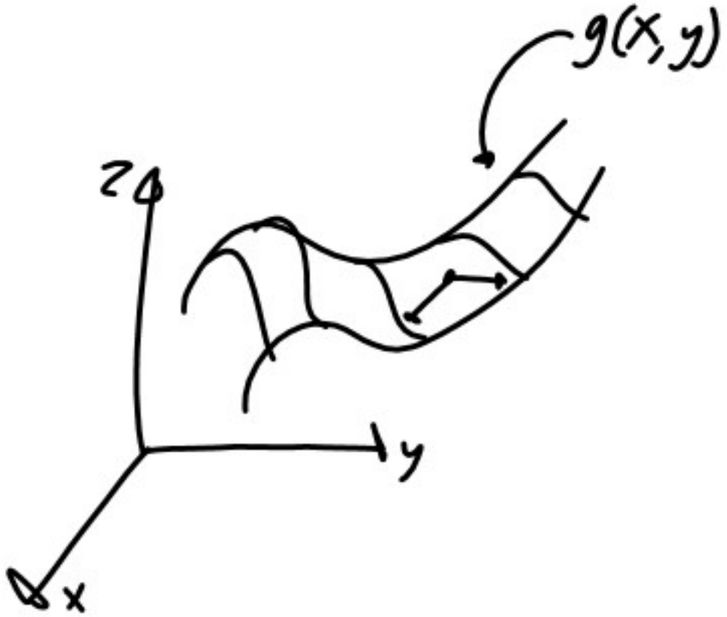
$$q'' = -k \nabla T$$

$$\frac{dT}{dx} = \frac{T_2 - T_1}{L}$$

$$q''_x = -k \frac{T_2 - T_1}{L}$$

Gradient (∇)



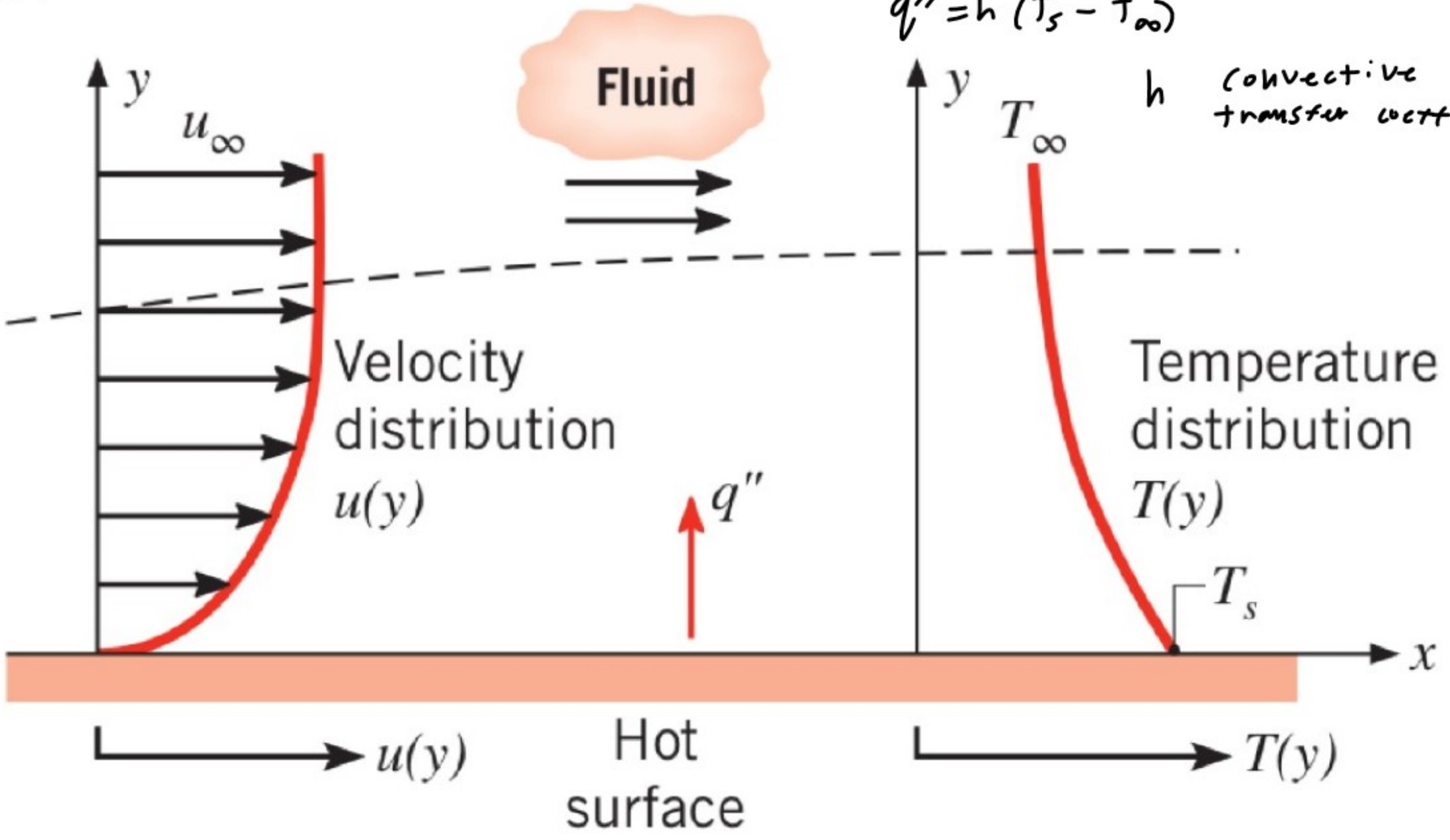


$$\nabla g = \frac{\partial g}{\partial x} i + \frac{\partial g}{\partial y} j$$

Convection

$q'' = h\,(T_s - T_\infty)$

h convective heat transfer coefficient

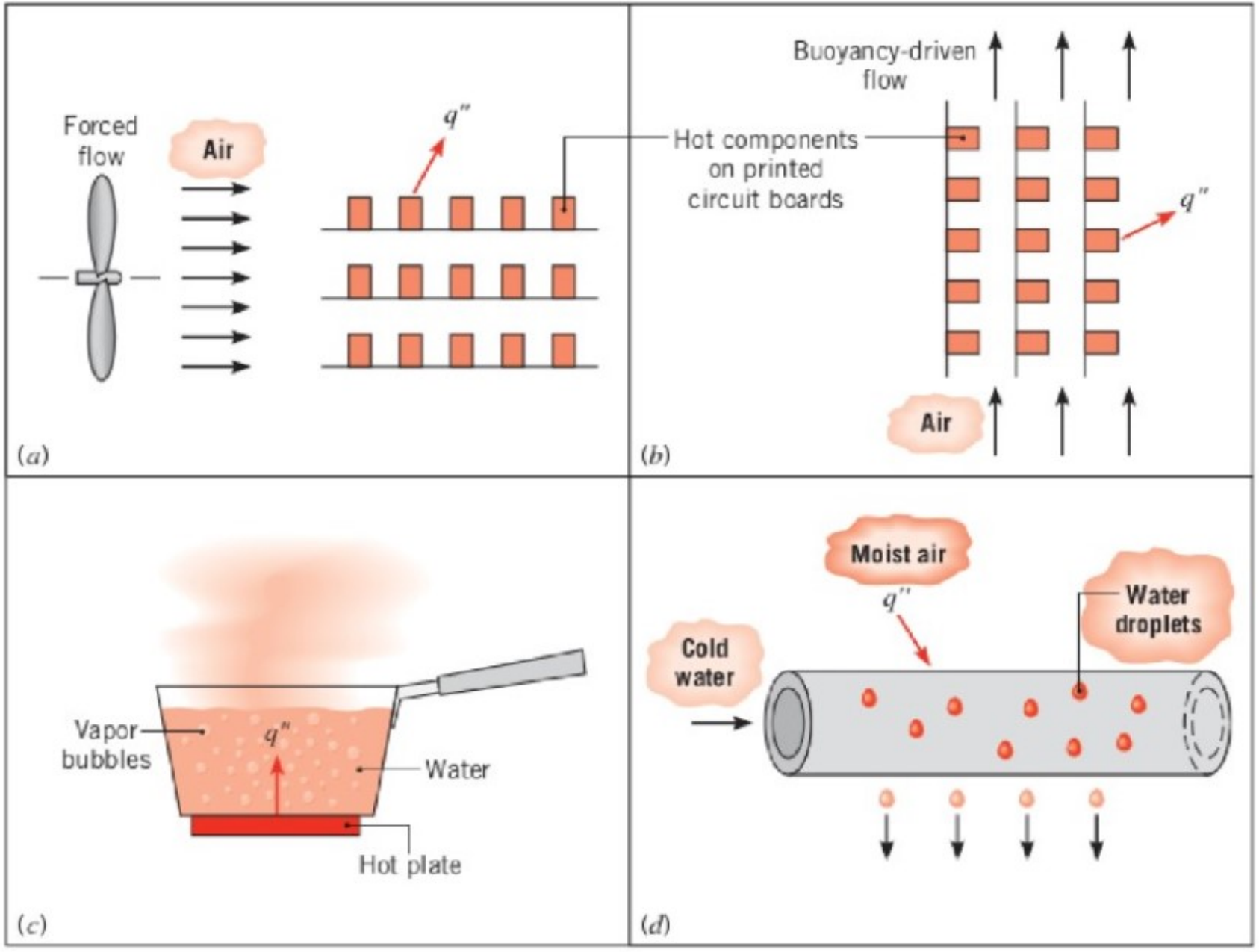


Forced Convection

Free Convection

Boiling

Condensation



Process	h ($W/m^2 \cdot K$)
Free convection	
Gases	2–25
Liquids	50–1000
Forced convection	
Gases	25–250
Liquids	100–20,000
Convection with phase change	
Boiling or condensation	2500–100,000

Radiation

radiation max flux

Stefan Boltzmann Law / Blackbody radiation

$E_b = \sigma T_s^4$

T_s surface K

σ Stefan Boltzmann Constant

For real surfaces

$E = \varepsilon \sigma T_s^4$

ε emissivity

Not all absorbed

$G_{abs} = \alpha G$

α absorptivity different for different types of radiation