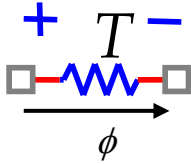
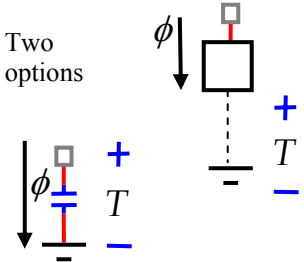
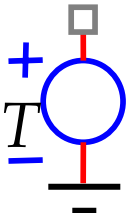
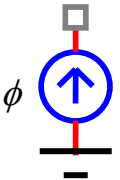


Thermal Elements

Element	Symbol	Element law	Energy storage	State	Units	Calculating value	Special notes
R_{th} (resistor)		$T = \phi R$	None	None	$^{\circ}\text{C}/\text{W}$	Conduction: $R = \frac{\ell}{kA}$ Block or rod with heat conduction along length ℓ , and with area A and thermal conductivity k Convection: empirical	
C_{th} (thermal capacitor aka thermal mass, m_T)	Two options 	$\phi = C dT/dt$ $dT/dt = \phi/C$	$H = C T$ (note difference relative to electrical!)	T	$\text{J}/^{\circ}\text{C}$	$C =$ (specific heat) (mass) $C =$ (specific heat) (volume) (depends on units in which specific heat is given)	Bottom plate is always grounded. Box symbol clarifies that.
T (temperature source)		$T = (\text{const})$ $\phi = \text{anything}$	Energy source or sink—don't know which.	None (can be an input)	$^{\circ}\text{C}$		Bottom plate is usually grounded.
ϕ (heat power source)		$\phi = P (\text{const})$ $T = \text{anything}$	Energy source	None (can be an input)	W	Heat flow input to a system is equal to power being dissipated as heat.	Bottom end is always grounded.

Initial conditions: Capacitor is only energy storage element; therefore, its temperature can't change instantaneously.

Some Values

Specific heat

	C_p [J/(g°C)]
Al	0.9
Cu	0.386
Steel	0.450
H ₂ O	4.19
Wood	1.7
Air	0.33 J/(m ³ °C)

Thermal conductivity [W/(m°C)]

Steel	44.5
Wood	0.11
Styrofoam	0.035
Al	200
Cu	389
Air	0.024

Variables

Name	Symbol	Units
Temperature	T, θ	°C, K
Heat	H, q	J
Heat flow	ϕ, q	W

Beware that some people use q for heat, yet others use it for heat flow!