

Heat and Temperature Are Not the Same

We all have common-sense notions of hot and cold. But in physics, we must define these concepts with absolute precision.

State Indicator

**Temperature =
measure**

A relative indication of hotness or coldness.

Energy in Transit

Heat = transfer

Energy moving from one system to another.

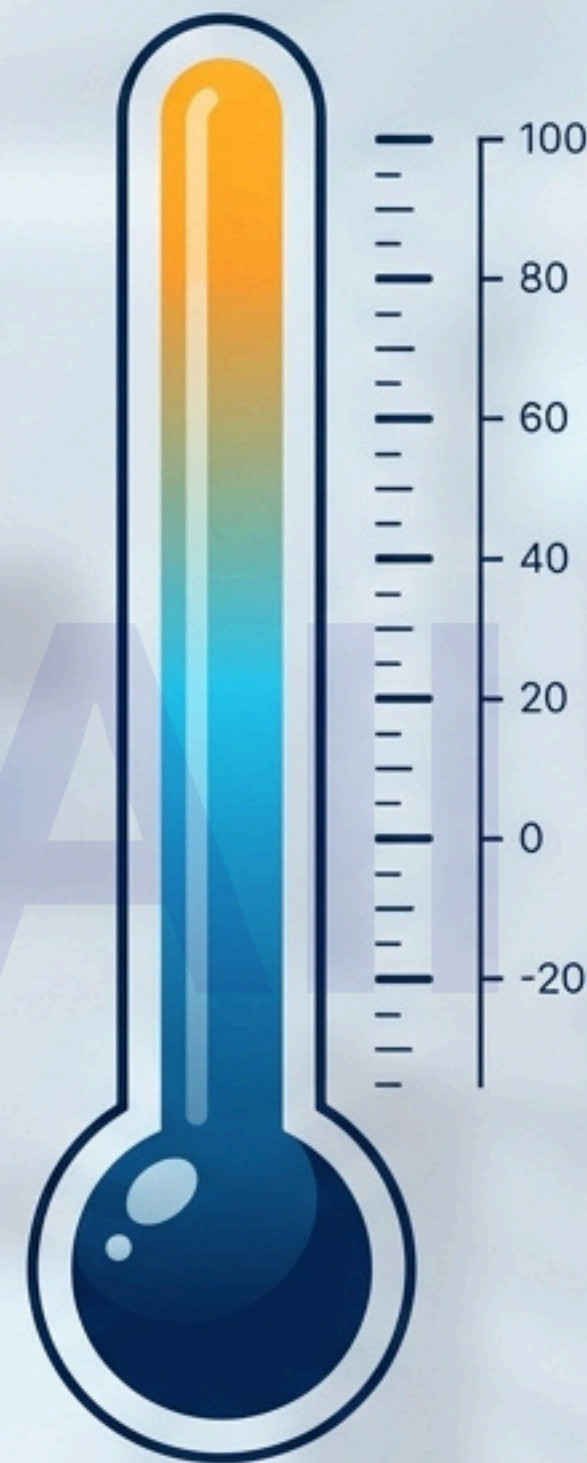
Practice more, score more

Temperature: The Measure of 'Hotness'

- Temperature is a relative measure, or indication of the hotness or coldness of a body.
- 'Hot' and 'cold' are relative terms, just like 'tall' and 'short'. A kettle with boiling water is hotter than a box containing ice.
- ✗ We can perceive temperature by touch, but human senses are too limited and unreliable for scientific purposes.

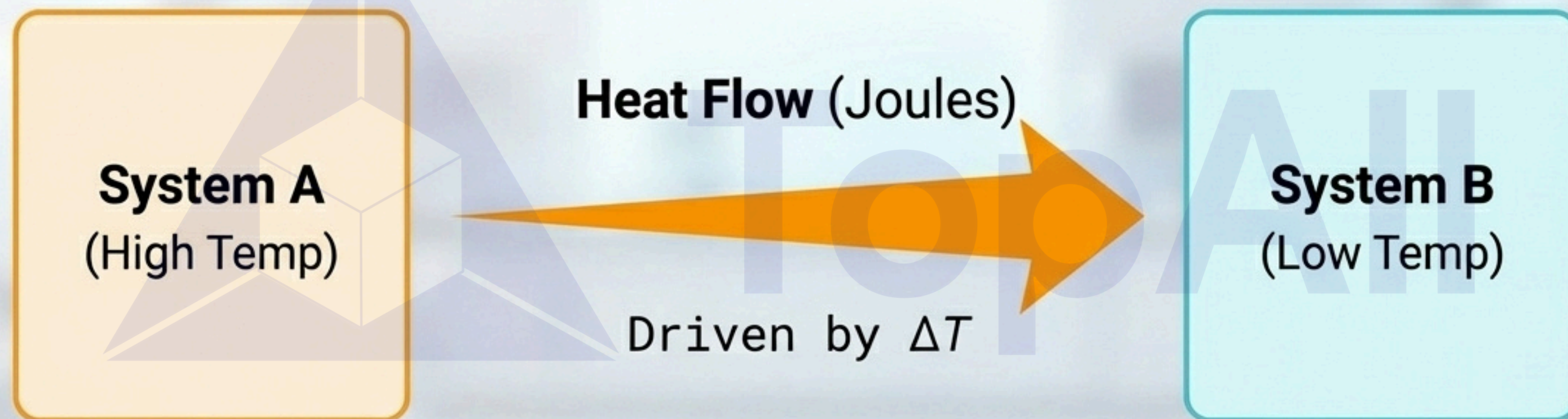
SI Unit = Kelvin (K)

Common Unit = Degree Celsius ($^{\circ}\text{C}$)



Heat: Energy in Transit

Heat is the form of energy transferred between two (or more) systems, or a system and its surroundings, by virtue of a temperature difference.



The Golden Rule: Heat only flows when there is a difference in temperature.

SI Unit of Heat Energy = Joule (J)

Practice more, score more

Observing the Direction of Heat Flow

Scenario 1: Ice-Cold Water

$$T_{\text{environment}} > T_{\text{glass}}$$



Heat Transfer
(Warms Up)

Scenario 2: Hot Tea

$$T_{\text{tea}} > T_{\text{environment}}$$

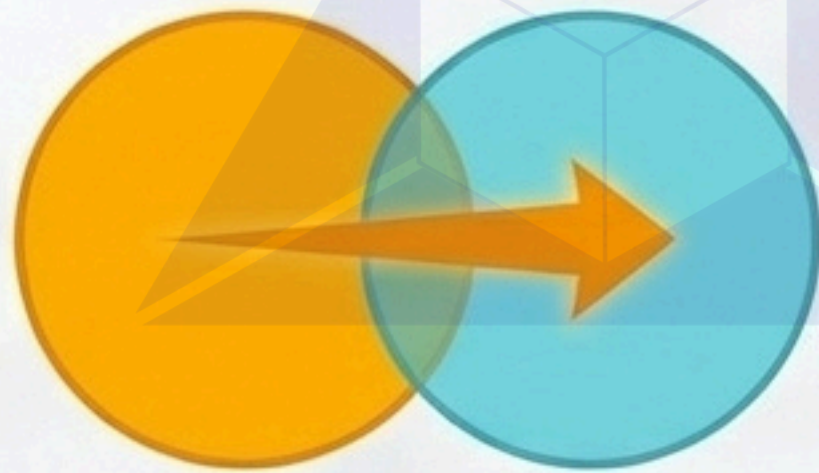


Heat Transfer
(Cools Down)

Reaching Thermal Equilibrium

Heat transfer between a system and its surroundings does not continue forever. It continues only until the body and the surrounding medium are at the exact same temperature.

Step 1
 $T_{\text{body}} \neq T_{\text{surroundings}}$



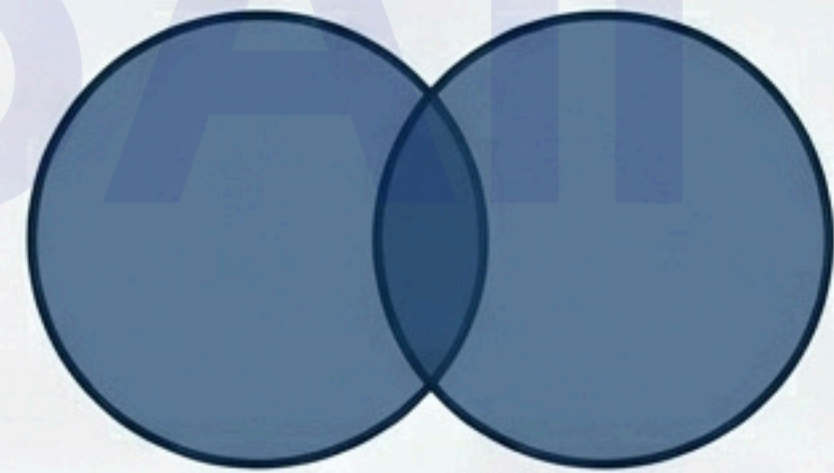
Step 2



Time passes

Step 3

$T_{\text{body}} = T_{\text{surroundings}}$



The Result: When $\Delta T = 0$, net heat transfer stops.

Key Takeaways & Exam Rule



Success Recap

- **Temperature:** Relative measure of hotness/coldness. (SI Unit: Kelvin)
- **Heat:** Energy transferred due to temperature difference. (SI Unit: Joule)
- **Equilibrium:** Heat flows until temperatures are equal.



Exam Trap

The Trap:

Thinking a hot object “contains a lot of heat.”

The Correction:

Temperature is a **state indicator**.
Heat is **energy transferred** because of a temperature difference.
Objects contain internal energy, not heat!