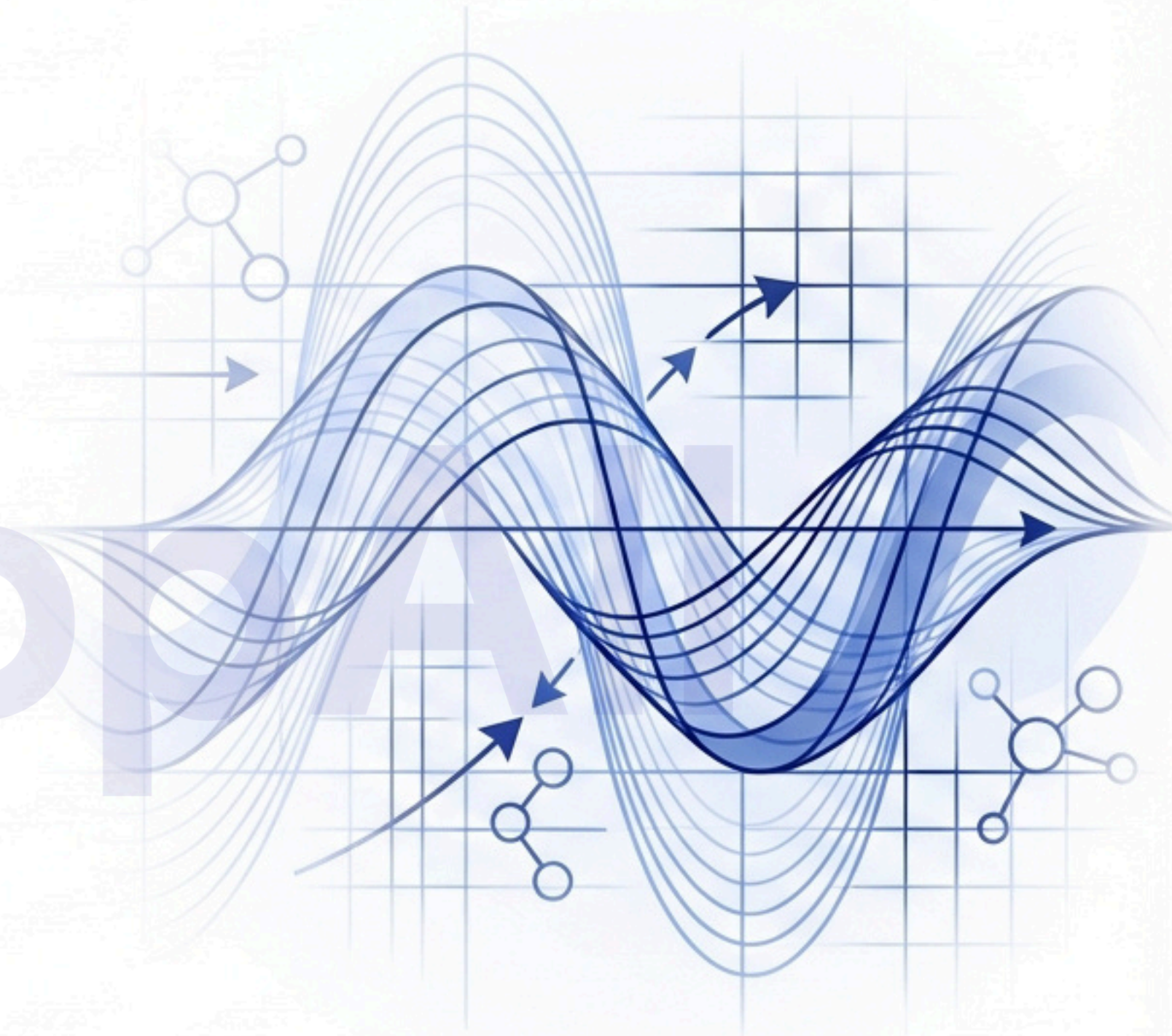


CHAPTER 11.6 | THERMODYNAMICS

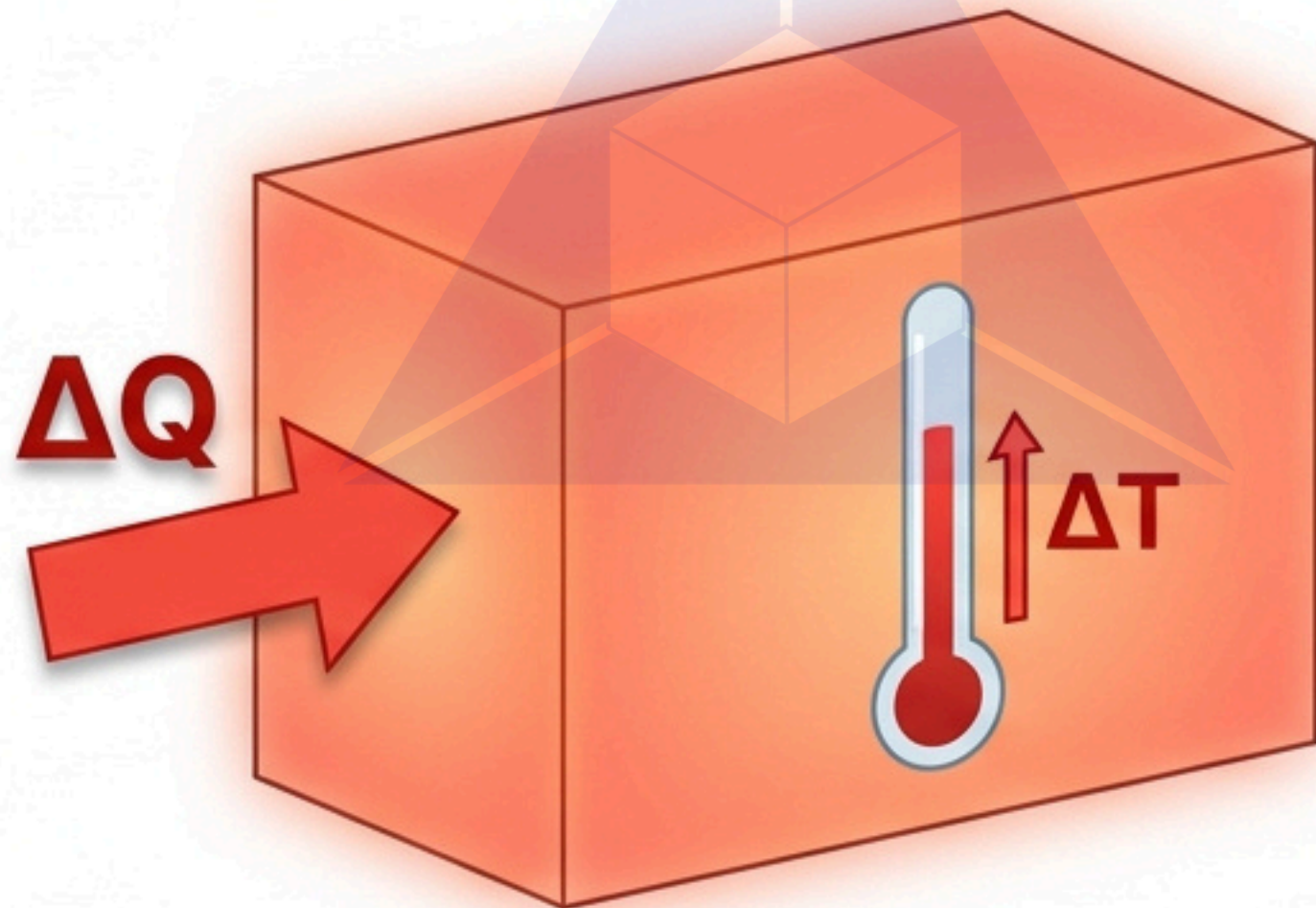
Specific Heat Capacity

Understanding heat transfer, mass, and molar properties in physics.



The Concept of Heat Capacity (S)

- Heat capacity is the amount of heat required to raise the temperature of a whole substance by a certain amount.
- It depends heavily on the total size and mass of the object.



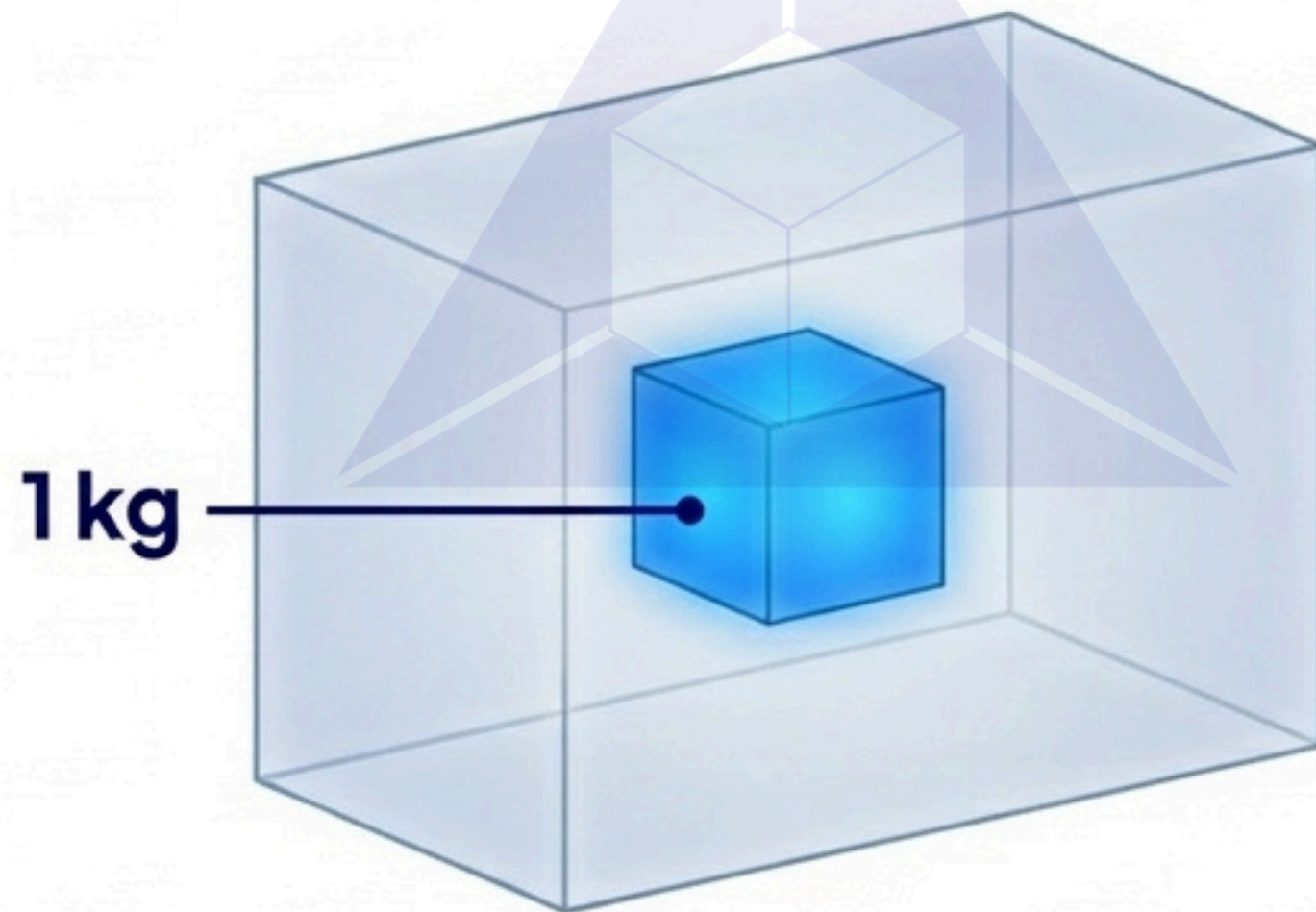
EQUATION 11.4

$$S = \frac{\Delta Q}{\Delta T}$$

ΔQ = Heat supplied, ΔT = Change in temperature

Standardizing by Mass

- To define a characteristic constant for a material (independent of its total amount), we divide Heat Capacity (S) by mass (m).
- s represents the heat required to raise the temperature of unit mass (1 kg) by 1 unit.



EQUATION 11.5

$$s = \frac{S}{m} = \frac{1}{m} \frac{\Delta Q}{\Delta T}$$

m = mass in kg, s = specific heat capacity



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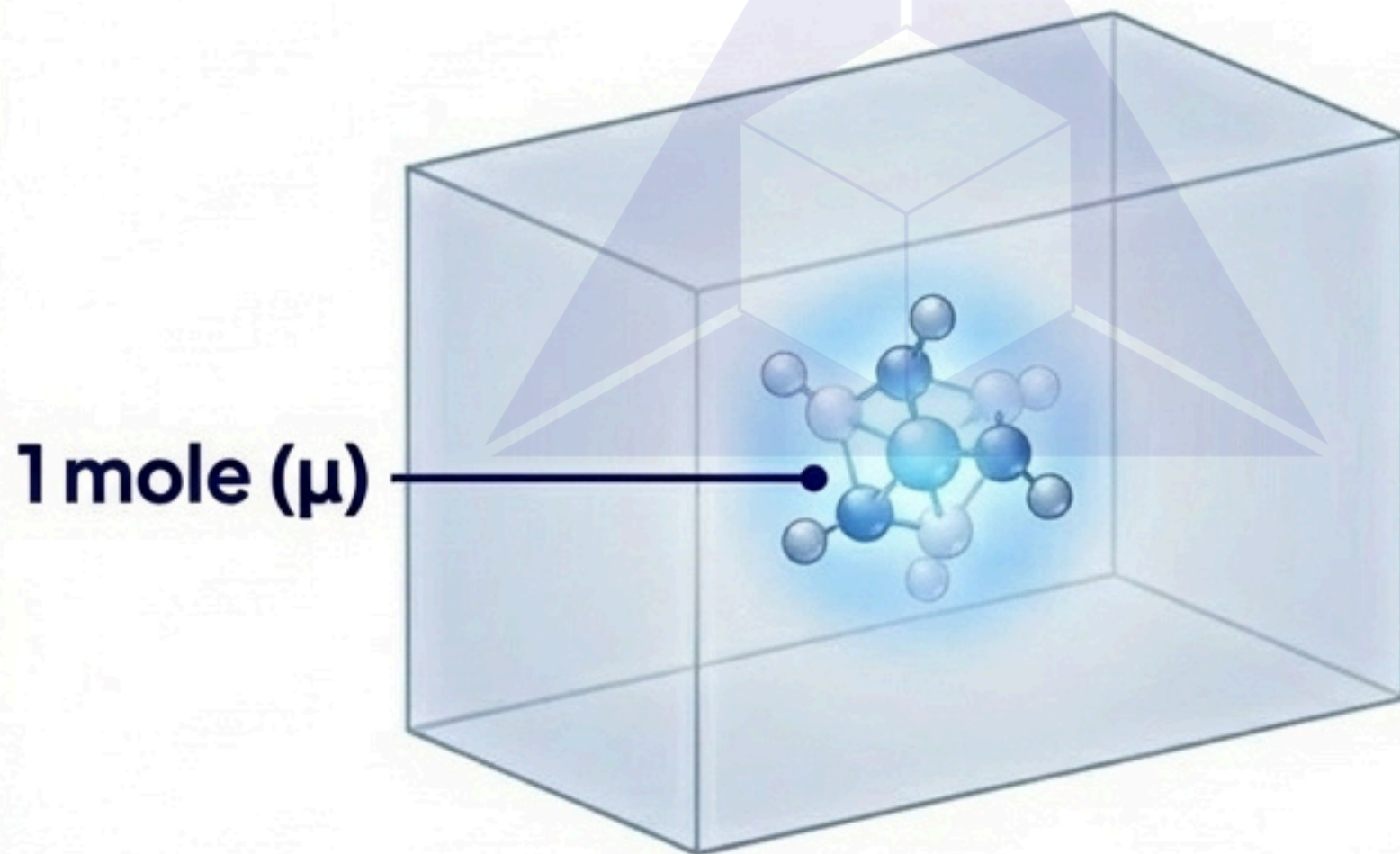
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Standardizing by Moles

- In chemistry and thermodynamics of gases/solids, it is often more useful to measure the substance in moles (μ) rather than kilograms.
- C represents the heat required to raise the temperature of 1 mole by 1 unit.



EQUATION 11.6

$$C = \frac{S}{\mu} = \frac{1}{\mu} \frac{\Delta Q}{\Delta T}$$

μ = number of moles, C = molar specific heat capacity

H2 Comparing the Capacities

Heat Capacity (S)

Total object

EXTENSIVE PROPERTY

J K^{-1}

Specific Heat (s)

Per 1 kg

INTENSIVE PROPERTY

$\text{J kg}^{-1} \text{K}^{-1}$

Molar Specific Heat (C)

Per 1 mole

INTENSIVE PROPERTY

$\text{J mol}^{-1} \text{K}^{-1}$

Heat Capacities of Solids

TABLE 11.1 (Room Temp & Constant Pressure)

Aluminum (Al):	$s = 900$	$C = 24.4$
Carbon (C):	$s = 506.5$	$C = 6.1$
Copper (Cu):	$s = 386.4$	$C = 24.5$
Silver (Ag):	$s = 236.1$	$C = 25.5$
Tungsten (W):	$s = 134.4$	$C = 24.9$

Exception

THE 3R RULE (EQUATION 11.7)

$$C \approx 3R \approx 25 \text{ J mol}^{-1} \text{ K}^{-1}$$

For most solids, molar specific heat approaches $3R$ due to the equipartition of energy (3-dimensional vibration).

Chapter Summary (Navy #000080)

Key Takeaways

- ✓ Heat Capacity (S) depends on the total mass of the object.
- ✓ Specific (s) and Molar (C) capacities are characteristic constants for the material itself.
- ✓ For solids at constant pressure, $C = 3R$ is a highly reliable approximation (except at very low temperatures).

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