HEAT random kinetic energy

ENTROPY measure of disorder

TEMPERATURE SCALES - conversion

\[ ^\circ C = \left( ^\circ F - 32 \right) \times \left( \frac{5}{9} \right) \quad ^\circ F = \left( ^\circ C \times \frac{9}{5} \right) + 32 \]

Absolute temperature \( K = ^\circ C + 273 \)

KINETIC THEORY matter = moving particles

\[ KE = \frac{1}{2} m v^2 = 3 \times \frac{1}{2} k T \]

\( k = \text{Boltzman's constant} = 1.38 \times 10^{-23} \text{ J/K} \)

SPECIFIC HEAT add heat, \( T \) increases

\[ H = mc(T_2 - T_1) = mc \Delta T \]

STATES of MATTER solid, liquid, gas

CHANGE of STATE

solid \( \Leftrightarrow \) liquid \( \quad H = mL_f \)

liquid \( \Leftrightarrow \) gas \( \quad H = mL_v \)

THERMAL EXPANSION all gases: \( V/V' = T/T' \)

solids depend on material: \( \Delta L = \alpha L(T_2 - T_1) = \alpha L \Delta T \)

THERMAL CONDUCTION

ENERGY CONVERSION

1st Law of Thermodynamics - in a closed system

- total \( E \) including heat is constant
- all other forms may be completely converted to heat

1 cal = 4.186 J

2nd Law of Thermodynamics - in a closed system

entropy (randomness) of total system increases

heat engine efficiency = \( (T_H - T_C)/T_H \)

WAVE disturbance carries energy through medium

WAVE MOTION PULSE or PERIODIC

period \( T \)  frequency \( f \)  \( T = 1/f \)

WAVELENGTH \( \lambda \)

WAVE EQUATION \( v = \lambda/T = \lambda f \)

\( v_{\text{light}} = c = 3 \times 10^8 \text{ m/s} \quad v_{\text{sound}} = 340 \text{ m/s} \)

AMPLITUDE

TYPES TRANSVERSE LONGITUDINAL

DOPPLER EFFECT change in \( f \) and \( \lambda \) with moving source

STANDING WAVE boundary conditions

node = no motion  antinode = maximum motion

FUNDAMENTAL FREQUENCY
SPEED OF LIGHT  constant in vacuum
   same for all electromagnetic radiation
   in matter v < c  index of refraction n = c/v > 1
REFLECTION  angle of incidence = angle of reflection
REFRACTION  bends at interface, depends on n
DIFFRACTION  spreads around corners
DISPERSION  prism, different f,λ different v
CONVERGING LENS
DIVERGING LENS
ELECTROMAGNETIC SPECTRUM
   radio, microwave, IR, visible, UV, X-ray, gamma ray
COLOR ⇒ f,λ  Red-Green-Blue Yellow-Magenta-Cyan