**Introduction to Thermal Properties of Matter**

The study of thermal properties of matter is a fundamental aspect of physics that explores how different materials respond to heat. This chapter delves into the concepts of heat, temperature, and the various ways in which heat can affect matter.

In this chapter, you will learn about:

1. **Temperature and Heat**: Understanding the difference between temperature, which measures the degree of hotness or coldness, and heat, which is the energy transferred due to temperature differences.
2. **Thermal Expansion**: How materials expand when heated and contract when cooled, and the practical implications of this behavior in everyday life.
3. **Specific Heat Capacity**: The amount of heat required to change the temperature of a substance, which varies from one material to another.
4. **Calorimetry**: The science of measuring the amount of heat involved in chemical reactions or physical changes.
5. **Change of State**: The transformation of matter from one state (solid, liquid, gas) to another, and the heat involved in these processes.
6. **Heat Transfer**: The mechanisms by which heat moves from one place to another, including conduction, convection, and radiation.

`(dQ)/(dt) = (kA(T\_{1} –T\_{2}))/L`

`(dQ)/(dt)` is thermal current

`dQ = -msdTtext( )dT` is the temperature of cooling

`(dT)/(dt) = (kA(T\_{1} – T\_{2}))/(msL)`

`(dT)/(dt)text( is rate of cooling)`

Thermal resistivity = `1/k`

`I = (v\_{2}-v\_{1})/Rtext( )R = (rhoL)/A= 1/kL/A`

Energy flux = `(dQ)/(dt)1/A`

&image&

r1

T1

T2

r2

`T\_{1} > T\_{2}`, so heat flows out from center to outside surface

`(dQ)/(dt) = (T\_{1} – T\_{2})/R`

`R = (r\_{2} – r\_{1})/(r\_{1}r\_{2}4pik)`

Series

&image&

T1

T2

A l1 l2

K1 k2

`R = 1/k\_{e}(l\_{1} +l\_{2})/A = R\_{1} + R\_{2} `

`K\_{e} = (k\_{1}k\_{2}(l\_{1} +l\_{2}))/(l\_{1}k\_{2} + l\_{2}k\_{1})`

Parallel

&image&

A1 l k1

T1

T2

A2 k2

`1/R\_{e} = 1/R\_{1} + 1/R\_{2}`

`K\_{e} = (k\_{1}A\_{1} + A\_{2}k\_{2})/(A\_{1} + A\_{2})`

Rocket case (or similar)

`F\_{thrust} –mg = matext( )f\_{thrust} = (dm)/(dt)\* v\_{rel}`

Stefan’s law (black body)

`(dQ)/(dt) = AsigmaT^4 `

Other bodies `(dQ)/(dt) = eAsigmaT^4`

e = a = 1 for black body

Rate of cooling

`(dT)/(dt) = (-eAsigma)/(ms)(T^4 – T\_{s}^4)`

Newtons cooling: `T\_{s} approx. T`

`(dT)/(dt) propto (T – T\_{s})`

Weins black body:

Toatal radiation power = `sigmaAT^4`

Displacement law

`lambda\_{m}T = b`

fifth power law

`I\_{m} propto T^5`