**THERMAL EXPANSION**

Each atom vibrates about its equilibrium position. When the temperature increases, the energy and amplitude of vibration also increase. The average distance between molecules also increases. As the atoms get farther apart, every dimension increases.

**LINEAR EXPANSION (SOLID MATERIALS)**

The relative change in length is directly proportional to change in temperature

α = coefficient of linear expansion

Δl = change in length = l - l0

l0 = initial length

ΔT = change in temperature = T – T0  (The temperature interval is the same in the kelvin and Celsius scales)

**THERMAL STRESS**

(When the thermal change of length is prevented)

E = modulus of elasticity, Young’s modulus

**VOLUME EXPANSION (SOLID, LIQUID)**

The relative change in volume is directly proportional to change in temperature

= coefficient of volume expansion; **for solid materials**

ΔV = change in volume = V - V0

V0 = initial volume

ΔT = change in temperature = T – T0

**THERMAL EXPANSION AND DENSITY**

= density at temperature T

= density at temperature T0

**VOLUME EXPANSION (GAS)**

**Ideal-gas\* equation**

p = pressure (absolute pressure)

V = volume of gas

T = temperature (Kelvin)

n = number of moles , n = m/M (M = molecular mass)

R = gas constant = 8,3145 J/mol·K

For a constant number of moles (= constant mass) nR is constant, so

\*An Ideal gas (a hypothetical gas ) is one for which equations above holds precisely for all pressures and temperatures. For other gases equations above are only a model. Most actual gases behave approximately as ideal gases, except at very low temperatures (when the potential energy of their intermolecular forces is high relative to the kinetic energy of the molecules and becomes significant), and under very high pressures (when the molecules are packed so close together that close-range intermolecular forces become significant).

**HEAT CAPACITY**

The quantity of heat Q required to increase the temperature of a mass of a certain material from T1 to T2 is approximately proportional to the change of temperature (ΔT = T2-T1) and also to the mass of material

, where c is specific heat capacity of the material.

The heat capacity (capital C) is a property of an object. C = mc)

**PHASE CHANGES**

Endothermic processes =

The change of the phase to the other **needs** energy

**Solid → (fusion) → Liquid → (vaporization) → Gas Solid → (sublimation) → Gas**

Exothermic processes =

The change of the phase to the other **gives up** energy

**Gas → (condensation) → Liquid → (stagnation) → Solid Gas → (deposition) → Solid**

The processes are reversible transitions. The magnitude of heat is same, but in the endothermic process we add the heat(energy) and in exothermic process we get the heat(energy)

**Fusion** (and stagnation):

**Q = mLf** , where Lf is the latent heat of fusion

**Vaporization** (and condensation):

**Q = mLv** , where Lv is the latent heat of vaporization