Summary of chapter 19

I. Objective:

1. Understand the concepts of thermal equilibrium and thermal contact between to bodies, and state the zeroth law of thermodynamics.

2. Describe the operation of the constant-volume gas thermometer and how is used to define the ideal-gas temperature scale.

3. Convert between the various temperature scales; degree Celsius-Kelvin, degree Fahrenheit kelvin, and degree Celsius – degree Fahrenheit.

4. Give a description of the origin of **thermal expansion of solids** and liquid and define **the linear** and **volume** expansion coefficient for **solids**.

5. Understand the properties of an ideal gas and **the equation of state** (perfect gas law).

II. Summary of major points:

1. If two bodies are in **thermal equilibrium** with each other they must have **the same temperature**.

2. ***The Zeroth-law of thermodynamics states that if two bodies A and B are separately in thermal equilibrium with a third body, C, then A and B are in thermal equilibrium with each other***

3. $T(^oC) = T\,(K) - 273$ and $T_F = 9/5\ T_C + 32\ (F^o)$

   $T\,(K) = 5/9\ TF + 255$

4. When a substance is heated, it generally expands. The change in length, A is related to the change in temperature and the proportionality constant is called α (coefficient of linear expansion)

5. For one dimensional expansion

   $\Delta L = L_i\, a\ \Delta T$ or $L_f = L_i\,(1 + a\Delta T)$

   For three dimensional expansion

   $\Delta V = bV_i\Delta T$ (Coefficient of volume expansion $\beta = 3\alpha$)

6. An ideal gas obeys the ***equation of state*** that interrelates the pressure, the volume and the temperature of the gas:

$$PV = n R T$$

or $$PV = Nk_BT$$

Here the temperature is in ***Kelvin***, n is the number of moles of the gas, k_B is Boltzman constant, R is the ideal gas constant.

$$nR \equiv Nk_B$$

The **number of moles n** of a substance is related to the mass m by;

$$n = \frac{m}{M}$$ where M is the molar mass and m is the mass of the substance

or the number of molecules N by;

$$n = \frac{N}{N_A}$$ where N_A is Avogadro number