Calorimetry

1. Calorimetery is the study of the measurement of quantities of heat.
2. Quantity of heat is the amount of molecular energy stored in a body.
3. **Calorie :** The quantity of heat required by one gram of water to raise its temperature from 14.5°C to 15.5°C is called one calorie.
4. British Thermal Unit : The amount of heat required by 1 Pound of water to raise its temperature by 1°F is called one British thermal unit.
5. Pound calorie : The amount of heat required by 1 Pound of water to raise its temperature by 1°C is called one pound calorie.
   1 pound calorie=453.6 calories
   1 calorie=4.186 joule

Heat Capacity

6. The amount of heat required to produce a specified change of temperature is directly proportional to the mass of the material.
7. For a given mass of material, the amount of heat absorbed is directly proportional to the temperature increase.
8. The amount of heat required to raise the temperature of the whole body by 1°C is called heat capacity or thermal capacity. Unit is J/K or Cal/°C.

$$C = \frac{dQ}{dT}$$

9. Specific heat : The quantity of heat required by one gram of a substance to raise its temperature by 1°C is called its specific heat.

   or

   Heat capacity per unit mass. Unit is J/Kg-K or Cal/g-°C.

$$s = \frac{dQ}{mdT}$$

$$dQ = msdT$$

10. If m is the mass and s is the specific heat of the material of the body, then the thermal capacity = ms cal/°C.
11. Of all solids and liquids, water has the highest specific heat or specific heat capacity. The value is 1 cal/g/°C or 4200 J/kg/K.
12. The specific heat of lead is the least among solids. (i.e., 0.03 cal/g/°C)
13. In liquids, mercury has least specific heat.
14. Of all solids, liquids and gases, hydrogen has the highest specific heat. It is equal to 3.5 cal/g/°C.
15. Specific heat depends upon the nature of the substance and does not depend upon mass, volume and heat supplied.
16. Specific heat of copper = 0.1 cal/g/°C.
    Specific heat of ice = 0.5 cal/g/°C
    Specific heat of steam = 0.45 cal/g/°C
    Specific heat of lead = 0.03 cal/g/°C.
17. Specific heat of a solid at its melting point is infinite.
18. Specific heat of a liquid at its boiling point is infinite.
19. The **water equivalent** of a body is the number of grams of water which require the same amount of heat as the substance for the same rise of temperature. Unit is grams.
    Water equivalent=ms grams.

20. Water equivalent is numerically equal to heat capacity.
21. **Latent heat (L)** is the quantity of heat required by unit mass of a substance to change its state at a constant temperature. Unit of L is cal/g or J/kg.
22. **Latent heat of fusion** is the quantity of heat required by unit mass of a solid to melt it at its melting point.
23. The latent heat of ice is 80 cal/g or 3.35×10^5 J/kg.
24. **Latent heat of vapourisation** is the quantity of heat required by unit mass of a liquid to vapourise it at its boiling point.
25. The latent heat of steam is 540 cal/g or 2.26×10^6 J/kg.
26. Latent heat of vapourisation of water decreases with the increase of pressure (i.e., increase of boiling point).
27. The latent heat of steam at boiling point t is given by L=600–0.06t.
28. Latent heat of vapourisation decreases with increase in temperature.
29. Latent heat of a substance becomes zero at critical temperature.
30. Latent heat depends on the nature of a substance and pressure.
31. During the change of state, the formula used to calculate the heat lost or heat gained is Q = mL.
32. When one gram of steam at 100°C is mixed with one gram of ice at 0°C, the resultant temperature will be 100°C and mass of steam condensed will be 1/3 gram.When one gram of ice is mixed with one gram of water at 80°C, the resultant temperature will be 0°C and the composition of mixture will be 2 grams of water.
33. Steam causes more burns than water at 100°C. The reason is that steam while condensing to water at 100°C gives out heat at the rate of 540 cal/g.
34. Calorific value of a fuel is the quantity of heat liberated when one gram of the fuel is burnt completely. Unit is cal/g or J/kg. It is determined by using Bomb calorimeter or Bell calorimeter.
35. Calorific value of a food stuff is the quantity of heat liberated when a unit mass of the food stuff is completely utilised by the body. Unit is cal/g or J/kg.
36. Steam is used in heat engines as working substance because of its high latent heat.
37. Heavy water is used as coolant in nuclear reactors because of its high specific heat.
38. In extinguishing fire hot water is preferred than cold water since hot water becomes vapour quickly and vapours do not allow fire.

LAW OF MIXTRUES (OR) CALORIMETRY PRINCIPLE

39. If no heat is lost or gained otherwise, the quantity of heat gained by the cold body is equal to the quantity of heat lost by the hot body. This is called the principle of the method of mixtures.
40. The principle of method of mixtures is Heat lost = Heat gained.
41. Calorimeter is generally made up of copper because it has low specific heat and high conductivity and hence attains the temperature of contents quickly.
42. To calculate the heat gained or lost when there is no change of state, we use the formula Q=mst.
43. When three substances of different masses m_1, m_2 and m_3 specific heats s_1, s_2, s_3 and at different temperatures t_1, t_2 and t_3 respectively are mixed, then the resultant temperature is

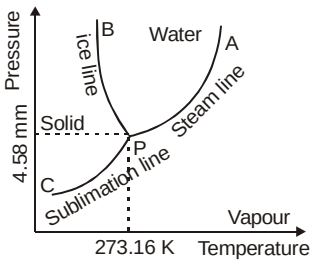
$$t = \frac{m_1 s_1 t_1 + m_2 s_2 t_2 + m_3 s_3 t_3}{m_1 s_1 + m_2 s_2 + m_3 s_3}$$

44. When “x” gram of steam is mixed with “y” gram of ice, the resultant temperature is

$$t = \frac{80(8x - y)}{(x + y)}$$

TRIPLE POINT

45. The temperature and pressure where solid, liquid and vapour states are co-exist is called triple point.
46. The triple point of water is 273.16 K (0.00750°C) and pressure 613.10 Pa (0.459 cm of Hg).



47. A graph drawn between the pressure and temperature representing the different states of matter is called the phase diagram.
48. PA is the steam line and along this line water and steam are in equilibrium state.
49. Above the line water exists and below steam exists.
50. The curve has positive slope showing the boiling point increases with pressure.
51. CP is called Hoar-frost line. Along this line ice and vapour coexist.
52. CP has positive slope.
53. PB is called ice line, along this line water and ice are in equilibrium.
54. Above the ice line water exists. The curve has negative slope showing the melting point decreases with increase of the pressure.