THERMAL PROPERTIES OF MATTER

Q.1 What is thermal energy ?

Ans: The total kinetic energy of all the molecules of the body is called thermal energy.

Q.2. Distinguish between heat and temperature.

Sl. No.	Heat	Temperature
1	Heat is a transfer of energy between two systems or a system and its surroundings by virtue of temperature difference.	Temperature is a measure degree of hotness or coldness of a body.
2	J (joule) is its SI unit.	K (kelvin) is its SI unit.
3	It is action	It is reaction

Q. 3 what property of material is used in designing thermometers.

Ans: Thermal expansion.

Q.4 Name the instrument commonly used to measure temperature.

Ans : Thermometer.

Q. 5. Which are the convenient temperature points of water are used normally while designing thermometer?

Ans : a) Ice point/ freezing point of water. b) steam point/ boiling point of water.

Q. 6. Write the relation between Fahrenheit and Celsius scales.

Ans: $t_F = 32 + \frac{9}{5}t_c$ OR $t_c = \frac{5}{9}(t_f - 32)$

Q.7.Write the value of ice point and steam point in Fahrenheit scale and Celsius scale

Details	Ice point	Steam point
Fahrenheit scale	32^0F	$212^0\ F$
Celsius scales	0^0C	100^0C

Q. 8. Write the relation between Celsius scale and kelvin scale of temperature.

Ans: T = (273.15 + t) Where T is temp. In kelvin scale and t is temp. in Celsius scale.

Q.9. State Boyle's law.

Ans: at constant temperature the pressure of a given mass of gas varies inversely as its volume.

$p \alpha \frac{1}{v}$ at constant temperature

pv=constant

Q.10. state charle's law.

Ans: at constant pressure the volume of a given mass of a gas is directly proportional to its absolute temperature.

V α T or $\frac{v}{T} = constant$

Q.11. Arrive at ideal gas law.

Ans: we know from Boyle's law pv = constant and from charle's law $\frac{v}{T} = constant$

Therefore $\frac{pv}{T} = constant$ = μR

Therefore pv = μRT where μ = number of moles of the gas

R = universal gas constant = 8.31 J/M/K

Q.12. what is thermal expansion?

Ans: The measure in the dimensions of a body due to increase in its temperature is called thermal expansion.

Q.13. Define coefficient of linear expansion.

Ans: $\alpha = \frac{(l_2 - l_1)}{l(t_2 - t_1)} = \frac{\Delta l}{l.\Delta T}$

It is the ratio of change in length to the original length.

Q.14. Define coefficient of volume expansion.

Ans: It is the ratio of change in volume to the original volume per degree rise in temperature

$\alpha_v = \frac{\Delta v}{v.\Delta T}$

Q.15. what is anomalous expansion of water?

Ans: Water contracts on heating between 0^0 C and 4^0 C. the volume of a given amount of water decreases as it is cooled from room temperature till 4^0 C, then volume increases and density decreases.

Q.16. what is the importance of anomalous expansion of water?

Ans: When water in lakes, ponds, rivers freezes at 4^0 C the density decreases and ice starts floating on water which helps as insulation for the further freeze. Water below ice layer remains as water and helps the animal and plant life inside it.

Q.17. Arrive at the relation between coefficient of linear and volume expansion.

Ans: Let α_l *and* α_v be the linear and volume expansion

We have $\alpha_l = \frac{\Delta l}{l.\Delta T}$; $\alpha_v = \frac{\Delta v}{v.\Delta T}$

$\Delta v = (l + \Delta l)^3 - l^3$

$= l^3 + \Delta l^3 + 3l^2\Delta l + 3l\Delta l^3 - l^3$

$= 3l^2\Delta l$ (neglecting power of Δl)

$= 3l^3\frac{\Delta l}{l} = 3v.\alpha_l \Delta T$

$\frac{\Delta v}{v.\Delta T} = 3\,\alpha_l = \alpha_v$

Therefore $\alpha_v = 3\alpha_l$

Q.18. Define heat capacity of a substance.

Ans: it is defined as the quantity of heat required to raise the temperature of a given substance by unit degree Celsius.

$S = \frac{\Delta Q}{\Delta T}$

Q.19. Define specific heat capacity . write its unit.

Asn: It is the quantity of heat required to raise the temperature of unit mass of a substance by one unit.

$S = \frac{1}{m}\frac{\Delta Q}{\Delta T}$ unit = J/Kg/K

Q.20. Define molar specific heat capacity and write its unit.

Ans: It is the quantity of heat required to raise the temperature of one mole of substance by one kelvin.

$C = \frac{1}{\mu}\frac{\Delta Q}{\Delta T}$ unit = J/mol/K

Q.20. Define specific heat at constant pressure and constant volume.

Q.21. What is calorimetry? Write principle of calorimetry.

Ans: It means measurement of heat.

Principle- Heat lost by one body = Heat gained

Q.22. What is calorimeter?

Ans: A device in which heat measurement can be made.

Q.23. Define the terms melting point and boiling point.

Ans: the temperature at which the solid and the liquid states of the substance are in thermal equilibrium with each other.

Q.24. What is regelation?

Ans: the phenomenon of refreezing when a wire cuts the ice slab due to pressure and passes through it without splitting is called regelation.

Q.25. What is normal boiling point?

Ans: The boiling point of a substance at atmospheric pressure is called normal boiling point.

Q.26. How boiling point depends on pressure?

Ans: When pressure is increased boiling point increases.

Q.27. Why cooking is difficult on hills?

Ans: At high altitudes, atmospheric pressure is lower , which reduces the boiling point.

Q.28. What is the principle involved in pressure cooker?

Ans: Boiling point increases with increase in pressure. Hence food gets cooked faster.

Q.29. What is sublimation?

Ans: the change from solid state to vapour state without passing through a liquid state.

Q.30. What is latent heat?

Ans: The quantity of heat required to change the state of the substance without change in temperetaure.

Q = mL $\quad L = \frac{Q}{m}$ $\quad$ unit = J/Kg

Q.31. Define the terms , latent heat of fusion and latent heat of vaporisation.

Ans: Latent heat of fusion – Quantity of heat required to change the state from solid to liquid at constant temperature.

latent heat of vaporisation - Quantity of heat required to change the state from liquid to vapour at constant temperature.

Q.32. Steam burns are more serious than boiling water burns why?

Ans: Latent heat of vaporisation = 22.6×10^5 J/Kg

This heat gets released when steam changes its state from vapour to liquid. Hence steam burns are more serious than boiling water burns.

Q.33. Mention the different methods of heat transfer.

Ans: Conduction , convection and radiation.

Q.34. What is conduction?

Ans: It is the mechanism of transfer of heat between two adjacent parts of a body because of there temperature differences.

Q.35. State laws of thermal conductivity.

Ans: The rate of flow of heat at steady state in a conductor of length L is proportional to the temperature difference and area of cross section A and inversely proportional to the length L.

$$H = KA\,\frac{T_c - T_o}{L}$$ where K = coefficient of thermal conductivity

Q.36. Define K-coefficient of thermal conductivity.

Ans: It is defined as the quantity of heat flowing through a conductor of unit length and unit area of cross section in unit time to have a temperature difference of 1^0 C.

S.I unit = J/S/mol/K or W/mol/K

Q.37. Why a layer of earth or foam insulation on the cooling of concrete roofs is preferred?

Ans: Houses made of concrete roofs get very hot during summer , because thermal conductivity of concrete is high. So to keep the rooms cooler it is preferred.

Q.38. Why cooking pots have copper coating on the bottom?

Ans: copper is a good conductor of heat, promotes distribution od heat over the bottom of a pot for uniform cooking.

Q.39. What is convection?

Ans: The process of transmission of heat by the actual motion of matter.

Q.40. What is trade wind?

Ans: Due to the rotation of the earth air closed to the equator has an east ward speed of 1600 Km/hr, while it is zero closed to the poles. As a result , the air descends not at the poles but at 30^0N latitude and returns to the equator is called trade wind.

Q.41. What is radiation?

Ans: It is a process of transmission of heat without affecting the intervening medium.

Q.42. write the properties of thermal radiation.

Ans: 1) They travel in straight line.

2) They are electromagnetic in nature.

3) They travel with speed of light.

4) They undergo reflection, refraction and interference.

5) They obey inverse square law.

Q.43. Why black cloths are preferred in water?

Ans: Black absorbs more heat and keep our body warm.

Q.44. State Newton's law of cooling.

Ans: The rate of loss of heat of the body is directly proportional to the difference of temperature of the body and its surroundings.

$-\frac{dQ}{dt} = K(T_2 - T_1)$ where K is constant.

Q.45. Derive the expression $T_2 = T_1 + e^{-kt+C}$ using Newton's law of cooling.

Ans: Let us consider a body of mass m and specific heat capacity S at temperature T_2. Let T_1 is temperature of surroundigs.

If the fall in tempetarure is dT_2 in time dt , then the amount of heat lost

$dQ = msdT_2$

Rate of heat lost $\frac{dQ}{dt} = ms\frac{dT_2}{dt}$ (1)

From Newton's law $-\frac{dQ}{dt} = K(T_2 - T_1)$ (2)

From (1) and (2) $ms\frac{dT_2}{dt} = -K(T_2 - T_1)$

$\frac{dT_2}{(T_2 - T_1)} = \frac{-K}{ms}dt = -Kdt$

$log_e(T_2 - T_1) = -Kt + C$

Therefore $T_2 - T_1 = e^{-kt+C}$

Therefore $T_2 = T_1 + e^{-kt+C}$