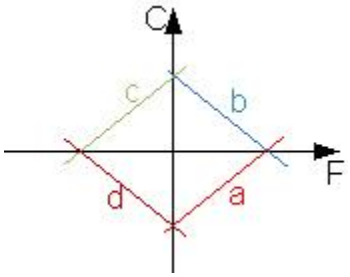
Heat : Subjective Questions (Typical)

No of Questions: 41 **Time Allotted: 2 Hours**

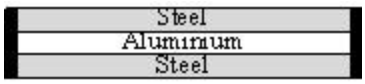
All questions are compulsory

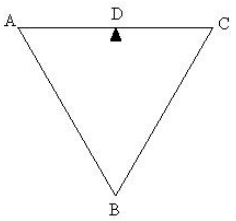
[Note: Figures are conceptual only and not to the scale]

Q-01	A system X is neither in thermal equilibrium with Y nor with Z. The systems Y and Z – (a) Must be in thermal equilibrium (b) Cannot be in thermal equilibrium (c) May be in thermal equilibrium
Q-02	Which of the curves represent relation between Celsius and Farenheit temperatures? 
Q-03	Which of the following pairs may give equal numerical values of the temprature of a body? (a) Fahrenheit and Kelvin (b) Celsuis and Kelvin (c) Kelvin and Platinum (d) Celsius and Platium
Q-04	For a constant volume gas thermometer, one should fill the gas at (a) Low temperature and low pressure (b) Low temperature and high pressure (c) High temperature and low pressure (d) High temprature and high pressure
Q-05	Consider the following statements- (I) The coefficient of linaer expansion has dimension K^{-1} (II) The coefficientof volume expansion has dimension K^{-1} Choose corret option (a) A and B are both correct (b) A is correct but B is wrong (c) B is correct but A is wrong (d) A and B are both wrong
Q-06	A metal sheet with a circular hole is heated. The hole – (a) Gets larger (b) Gets smaller (c) Remains of the same size (d) Gets deformed

Q-07	Two identical rectangular strips, one of copper and the other of steel, are rivetted together to form a bimetallic strip $\left(\alpha_{\text{copper}} > \alpha_{\text{steel}}\right)$, On heating, this strip will (a) Remain straight (b) Bend with copper on convex side (c) Bend with steel on convex side (d) Get twisted
Q-08	If the temperature of a unfirm rod is slightly increased by Δt, its moment of inertia I about a perpendicular bisector increases by (a) Zero (b) $\alpha I \Delta t$ (c) $2\alpha I \Delta t$ (d) $3\alpha I \Delta t$
Q-09	If the temperature of a uniform rod is slightly increased by Δt, its moment of inertia I about a line parallel to itself will be increased by (a) Zero (b) $\alpha I \Delta t$ (c) $2\alpha I \Delta t$ (d) $3\alpha I \Delta t$
Q-10	The temperature of water at the surface of a deep lake is 2^0C. The temperature expected at bottom is (a) 0^0C (b) 2^0C (c) 4^0C (d) 6^0C
Q-11	An aluminium sphere is dipped into water at 10^0C. If the temperature is increased, the force of buyoancy (a) Will increase (b) Will decrease (c) Will remain constant (d) May increase or decrease depending on the radius of sphere
Q-12	A spinning wheel is brought in contact with an identical wheel spinning at identical speed. The wheel slows down under action of friction. Which of the following energies of the first wheel decrease? (a) Kinetic (b) Total (c) Mechanical (d) Internal
Q-13	A body A is placed on a railway platform and an identical body B in a moving train.Which of the following energies of B are greater than those of A as seen from the ground? (a) Kinetic (b) Total (c) Mechanical (d) Internal
Q-14	In which of the following pairs of temperature scales, the size of a degree is identical? (a) Mercury scale and ideal gas scale (b) Celsius scale and mercury scale (c) Celsius scale and ideal gas scale (d) Ideal gas scale and absolute scale

Q-15	A sold object is placed in water contained in an adibatic container for some time. The temperature of water falls during the period and there is no appreciable change in the shape of the object. The temperature of the solid object (a) Must have increased (b) Must have decreased (c) May have increased (d) May have remained constant
Q-16	As the temperature is increased, the time period of a pendulum (a) Increases proportional with temperature (b) Increases (c) Decreases (d) Remains constant
Q-17	The steam point and ice point of a mercury thermometer are marked as 80^0 and 20^0. What will be the temperature in centigrade mercury scale when this thermometer reads 32^0?
Q-18	A constant volume thermometer registers a pressure of 1.500×10^4 Pa at the triple point of water and a pressure of 2.050×10^4 Pa at normal boiling point. What is the temperature at the normal boiling point?
Q-19	A gas thermometer measures the temperature from the variation of pressure of a sample of gas. If the pressure measured at the melting point of lead is 2.20 times the pressure measured at the triple point of water, find melting point of lead.
Q-20	In a Callender's compensated constant pressure air thermometer, the volume of the bulb is 1800 cc. When the bulb is kept immersed in a vessel, 200 cc of mercury has to be poured out. Calculate the temperature of the vessel.
Q-21	A platinum resistance thermometer reads 0^0 when its resistance is $80\,\Omega$ and 100^0 when its resistance is $90\,\Omega$. Find the temperature at the platnum scale at which the resistanc is $86\,\Omega$.
Q-22	A resistance thermometer reads $R = 20.0\,\Omega, 27.5\,\Omega$ and $50.0\,\Omega$ at the ice point (0^0 C), the steam point (100^0 C) and zinc point (420^0 C), respectively. Assuming that the resistance varies with temperature as $R_\theta = R_0\left(1+\alpha\theta+\beta\theta^2\right)$, find the values of R_0, α and β. Here, θ represents the temperature on Celsius scale.
Q-23	A metre scale made of steel is calibrated at 20^0C to give corrected reading. Find the distance between 50 cm mark and 51 cm mark if scale is used at 10^0C. Coefficient of linear expansion of steel is $1.1\times10^{-5}\ {}^0\text{C}^{-1}$.
Q-24	A railway track (made of iron) is laid in winter when the average temperature ia 18^0 C. The track consists of section of length 12.0 m placed one after the other. How much gap should be left between two such sections so that there is no compression during summer when the maximum temperature goes to 48^0C? Coefficient of linear expansion of iron is $1.1\times10^{-5}\ {}^0\text{C}^{-1}$.
Q-25	Two meter scales, one of steel and the other of aluminium, agree at 20^0C. Calculate the ratio aluminuim-centimetre/steel-centimetre at (a) 0^0C, (b) 40^0C and (c) 100^0C. Coefficient of linear expansion α for steel and aluminium are $1.1\times10^{-5}\ {}^0\text{C}^{-1}$ and $2.3\times10^{-5}\ {}^0\text{C}^{-1}$ respectively.
Q-26	A metre scale made of steel reads accurately at 20^0C. In a sensitive experiment, distances accurate upto 0.055 mm in a 1 m are required. Find the range of temperature in which the experiment can be performed with this scale. For seel $\alpha = 1.1\times10^{-5}\ {}^0\text{C}^{-1}$.

Q-27	Density of water at 0^0c is 0.998 g.cm^{-3} and at 4^0C is 1.000 g.cm^{-3}. Calculate coefficient of volume expansion of water in tempeture range 0 to 4^0C.
Q-28	A pendulum clock gives correct time at 20^0C at a place where $g = 9.800\,\text{m}\cdot\text{s}^{-2}$. The pendulum consists of a light steel rod connected to a heavy ball. It is taken to a different place where $g = 9.788\,\text{m}\cdot\text{s}^{-2}$. At what temperatur will it give correct time ? For Steel rod $\alpha = 1.2\times10^{-5}\ ^0\text{C}^{-1}$
Q-29	An aluminuim plate fixed in a horizontal position has a hole of diameter 2.000 cm. A steel sphere of diameter 2.005 cm rests on this hole/ All lengths refer to a temperture of 10^0C. The temperature of the entire system is slowly increased. At what temperature will the ball fall down. Coefficient linear expansion α for steel and aluminium are $1.1\times10^{-5}\ ^0\text{C}^{-1}$ and $2.3\times10^{-5}\ ^0\text{C}^{-1}$ respectively.
Q-30	The volume of a glass vessel is 1000 cc at 20^0 C. What colume of mercury should be poured into it at this temperature so that the volume of the remaining space does not change with tenperature? Coefficients of cubical expansion of mercury and glass are $1.8\times10^{-4}\ ^0\text{C}^{-1}$ and $9.0\times10^{-6}\ ^0\text{C}^{-1}$ respectively.
Q-31	The densities of wood and benzene at 0^0C are 800 kg-m^3 and 900 kg-m^3 respectively. The coefficient of volume expansion for wood and benzene are $1.2\times10^{-3}\ ^0\text{C}^{-1}$ and $1.5\times10^{-3}\ ^0\text{C}^{-1}$ respectively. At what temperature will a piece of wood just sink in benzene
Q-32	A steel rod of length 1 m rests on a smooth horizontal base. If it is heated from 0^0C to 100^0C, what is the longitudinal strain developed in the rod?
Q-33	A steel wire of cross-sectional area 0.5 mm^2 is held between two fixed supports. If the wire is just taught at 20^0C, determine the tension when the temperature falls to 0^0C. Coefficient of linear expansion of steel ia $1.2\times10^{-5}\ ^0\text{C}^{-1}$ and its Young's modulus is $2.0\times10^{11}\,\text{Nm}^{-2}$.
Q-34	Two steel rods and an aluminium rod of equal length l_0 and equal cross section are joined rigidly at either ends as shown in the figure. All the rods are in a state of zero tension at 0^0C. Find the length of the system when temperature is raised to θ. Coefficient of linear expansion of aluminium and steel are α_a and α_s respectively while their Young's Modulus of elasticity are Y_a and Y_s respectively. 
Q-35	A steel ball initially at a pressure of 1.0×10^6Pa is heated from 20^0C to 120^0C keeping its volume constant. Find the presure inside the ball. Coeffcient of linear expansion of steel is $1.2\times10^{-5}\ ^0\text{C}^{-1}$ and its bulk modulus of is $1.6\times10^{11}\,\text{Nm}^{-2}$.
Q-36	Show that moment of inertia of a solid body of any shape changes with temperature as $I = I_0(1+2\alpha\theta)$, where I_0 is moment of inertia of the body at 0^0C, α is coefficient of linear expansion of the solid.
Q-37	A torsional pendulum consists of a solid disc connected to a thin wire, having coefficient of linear expansion $\alpha = 2.4\times10^{-5}\ ^0\text{C}^{-1}$, at its centre. Find the percentage change in the time period between peak winter and peak summer when temperatures are 5^0C and 45^0C.
Q-38	Two metal rods of different metals of equal length and cross-section are fixed endto end between two rigid supports. The system is heated up. Find necessary condition so that the position of the junction of the two rods does not shift. Given that coefficients of linear expansion of the two rods are α_1 and α_2 respectively and their

	Young's Modulus of elasticity are Y_1 and Y_2 respectively
Q-39	What will be the stress at -20^{0}C in steel rod having tensile load of 5000 N at 20^{0}C, Cross-sectional area of the rod is 150 mm^2 and it is stretched between two fixed points. Given that for the rod $\alpha = 11.7\times10^{-6}\ /^0\text{C}$ and $Y = 2.00\times10^{13}\ \text{N}\cdot\text{m}^{-2}$
Q-40	An equilateral triangle ABC is formed by joining three rods of equal length and is in equilibrium on mid-point D of one of its side AC in horizontal position. Coefficient of linear expansion of the horizontal side is α_1, while the coefficient for other two sides is α_2. Find relation between α_1 and α_2 if distance BD between the mid-point and the lower vetex of the triangle remains constant. 
Q-41	If two rods of length L and 2L having coefficient of linear expansion α and 2α respectively are connected to get a rod of length 3L. Find the average coefficient of linear expansion of the composite rod.