EXERCISE-II (SUBJECTIVE QUESTIONS)

1. We have a hollow sphere and a solid sphere of equal radii and of the same material. They are heated to raise their temperature by equal amounts. How will the change in their volumes, due to volume expansions, be related ? Consider two cases (i) hollow sphere is filled with air, (ii) there is vaccum inside the hollow sphere.

2. The time represented by the clock hands of a pendulum clock depends on the number of oscillation performed by pendulum every time it reach to its extreme position the second hand of the clock advances by one second that means second hand move by two second when one oscillation in complete

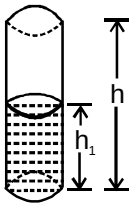
(a) How many number of oscillations completed by pendulum of clock in 15 minutes at calibrated temperature 20°C

(b) How many number of oscillations are completed by a pendulum of clock in 15 minute at temperature of 40°C if $\alpha = 2 \times 10^{-5}$c

(c) What time is represented by the pendulum clock at 40°C after 15 minutes if the initial time shown by the clock is 12: 00 pm ?

(d) If the clock gains two second in 15 minutes then find - (i) Number of extra oscillation (ii) New time period (iii) change in temperature.

3. Consider a cylindrical container of cross section area 'A', length 'h' having coefficient of linear expansion α_c. The container is filled by liquid of real expansion coefficient γ_L up to height h_1. When temperature of the system is increased by $\Delta\theta$ then



(a) Find out new height, area and volume of cyclindrical container and new volume of liquid.

(b) Find the height of liquid level when expansion of container is neglected.

(c) Find the relation between γ_L and α_c for which volume of container above the liquid level.
(i) increases (ii) decreases (iii) remains constant.

(d) If $y_\ell > 3\alpha_C$ and $h = h_1$ then calculate, the volume of liquid overflow

(e) What is the relation between γ_ℓ and α_c for which volume of empty space becomes independent of change of temp.

(f) If the surface of a cylindrical container is marked with numbers for the measurement of liquid level of liquid filled inside it. If we increase the temperature of the system be $\Delta\theta$ then

(i) Find height of liquid level as shown by the scale on the vessel. Neglect expansion of liquid

(ii) Find height of liquid level as shown by the scale on the vessel. Neglect expansion of container

(iii) Find relation between γ_L and α_c so that height of liquid level with respect to ground

(1) increases (2) decreases (3)remains constant.

4. A loaded glass bulb weighs 156.25 g in air. When the bulb is immersed in a liquid at temperature 15ºC, it weighs 56.25 g. On heating the liquid, for a temperature upto 52ºC the apparent weight of the bulb becomes 66.25 g. Find the coefficient of real expansion of the liquid. (Given coefficient of linear expansion of glass = 9×10^{-6}/ºC).

5. A body is completely submerged inside the liquid. It is in equilibrium and in rest condition at certain temperature. It γ_L volumetric expansion coefficient of liquid α_s = linear expansion coefficient by of body. It we increases temperature by $\Delta\theta$ amount than find

(a) New thrust force if initial volume of body is V_0 and density of liquid is d_0.

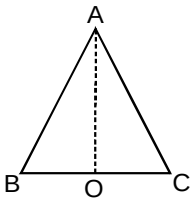
(b) Relation between α_s and γ_L so body will (i) move upward (ii) down ward (iii) remains are rest

6. A clock pendulum made of invar has a period of 0.5 sec at 20°C. If the clock is used in a climate where average temperature is 30° C, aporoximately. How much fast or slow will the clock run in 10^6 sec. ($\alpha_{invar} = 1 \times 10^{-6}$/°C)

7. An iron bar (Young's modulus = 10^{11} N/m^2, $\alpha = 10^{-6}$/°C) 1 m long and 10^{-3} m^2 in area is heated from 0°C to 100°C without being allowed to bend or expand. Find the compressive force developed inside the bar.

8. Three aluminium rods of equal length form an equilateral triangle ABC. Taking O (mid point of rod BC) as the origin.Find the increase in Y-coordinate of center of mass per unit change in temperature of the system. Assume the length of the each rod is

2m, and $\alpha_{al} = 4\sqrt{3} \times 10^{-6}$/ °C



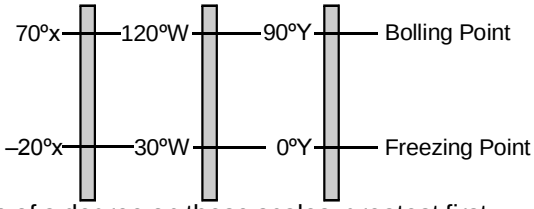
9. If two rods of length L and 2L having coefficients of linear expansion α and 2α respectively are connected so that total length becomes 3L, determine the average coefficient of linear expansion of the composite rod.

10. A thermostatted chamber at small height h above earth's surface maintained at 30°C has a clock fitted in it with an uncompensated pendulum. The clock designer correctly designs it for height h, but for temperature of 20°C. If this chamber is taken to earth's surface, the clock in it would click correct time. Find the coefficient of linear expansion of material of pendulum.(earth's radius is R)

11. The coefficient of volume expansion of mercury is 20 times the coefficient of linear expansion of glass Find the volume of mercury that must be poured into a glass vessel of volume V so that the volume above mercury may remain constant at all temperature.

12. A metal rod A of 25 cm lengths expands by 0.050 cm. When its temperature is raised from 0°C to 100°C. Another rod B of a different metal of length 40cm expands by 0.040 cm for the same rise in temperature. A third rod C of 50 cm length is made up of pieces of rods A and B placed end to end expands by 0.03 cm on heating from 0° C to 50°C. Find the lengths of each portion of the composite rod.

13. The figure shows three temperature scales with the freezing and boiling points of water indicated.



(a) Rank the size of a degree on these scales, greatest first.
(b) Rank the following temperatures, highest first 50ºX, 50ºW and 50ºY.

14. What is the temperature at which we get the same reading on both the centigrade and Fahrenheit scales ?