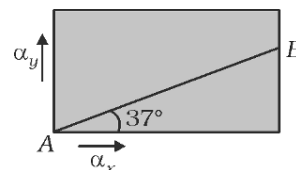


Properties of Matter

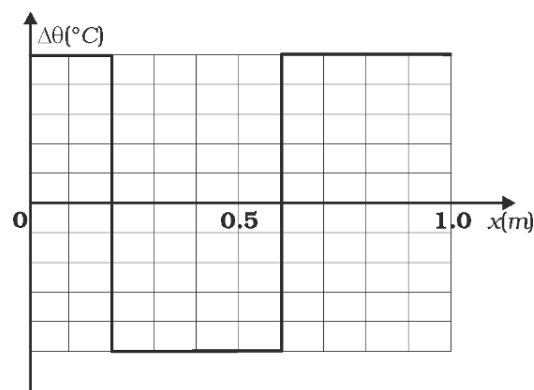
Date Planned : __ / __ / __	Daily Tutorial Sheet - 12	Expected Duration : 90 Min
Actual Date of Attempt : __ / __ / __	Level - 3	Exact Duration : _____

- 141.** A block of mass 100 g and temperature 0°C is immersed in a calorimeter containing 500 g water at temperature 45°C . Specific heat s of the material of the block depends on temperature θ according to equation $s = s_0(1 + k\theta)$, where $s_0 = 4.2 \times 10^3 \text{ J/(Kg}^\circ\text{C)}$, $k = 0.10^\circ\text{C}^{-1}$ and θ is temperature in degree Celsius. Find final temperature of water in the calorimeter. Neglect heat capacity of the calorimeter and loss of heat to the surroundings. Specific heat of water is $4.2 \times 10^3 \text{ J/(Kg }^\circ\text{C)}$
- 142.** A vessel contains $V_i = 20\text{L}$ water at temperature $\theta_i = 20^\circ\text{C}$. When a heater inside the container, which can supply heat at constant rate, is switched on, the water temperature reached a value of $\theta_1 = 60^\circ\text{C}$ within a time interval $\Delta t_1 = 40 \text{ min}$. Now water of temperature $\theta_i = 20^\circ\text{C}$ is slowly added into the vessel at a constant rate $r = 200 \text{ cm}^3 / \text{min}$. Heat capacity of the vessel and heat loss to the surroundings are negligibly small.
- (i) How long after the beginning of the experiment, will water start boiling? Boiling point of water is $\theta_b = 100^\circ\text{C}$.
- (ii) If instead of water, some other liquid having all properties same as those of water except the boiling point that is 150°C , is used, how long after the beginning of the experiment, will the mixture start boiling? The liquid is miscible in water.
- 143.** A lead pellet is embedded in an ice ball. Mass of ice in the ball is $M = 0.9 \text{ kg}$ and its temperature is $\theta = -42^\circ\text{C}$. When the ice ball is gently released on the surface of water kept at temperature $\theta_0 = 0^\circ\text{C}$ in a large container, it first sinks to the bottom and then after some time it comes out and floats partially submerged in water. Find the range of values of mass m of the lead pellet.
- Densities of water, lead and ice are $\rho_w = 1.0 \text{ g/cm}^3$, $\rho_p = 11 \text{ g/cm}^3$ and $\rho_i = 0.9 \text{ g/cm}^3$ respectively. Specific heat of ice is $s = 2.4 \text{ J/(g}^\circ\text{C)}$ and specific latent heat of melting of ice is $L = 336 \text{ J/g}$. Heat capacity of the lead pellet is negligibly small as compared to that of the ice ball.
- 144.** Two identical thermally insulated cylindrical calorimeters of height $h = 75 \text{ cm}$ are filled to one third of their capacity. One calorimeter is filled with ice at temperature below freezing point and the second is filled with water at $T_w = 10^\circ\text{C}$. Water from the second calorimeter is poured into the first one, and as a result it gets filled to two-third of its capacity. When the temperature is stabilized in the first calorimeter, its level of water increases by $\Delta h = 0.5 \text{ cm}$. The density of ice is $\rho_{ice} = 0.9\rho_{water}$, the latent heat of fusion of ice is $L = 340 \text{ kJ/kg}$, the specific heat of ice is 2.1 kJ/(kg K) and the specific heat of water is $C_w = 4.2 \text{ kJ/(kg K)}$. Determine the initial temperature of ice in the first calorimeter.

- 145.** You are given a flat rectangular metal sheet made of an anisotropic material whose coefficients of linear expansion are α_x and α_y along two mutually perpendicular lines shown in figure. If $\alpha_x = \frac{25}{4}$ units and $\alpha_y = \frac{25}{9}$ units, find coefficient of linear expansion along line AB (in the same unit).



- 146.** With the help of some arrangement, different portions of a uniform metal rod of length 1.0 m placed on a frictionless horizontal table top are maintained at different temperatures as shown in the given graph. Here $\Delta\theta$ is deviation in temperature of a point from room temperature and x is distance of the point from the left end of the rod. After a steady state is established, total extension of the rod is found to be Δl .



- (i) Find points on the rod that do not shift.
- (ii) Find displacements of both the ends of the rod.