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DPP – Thermal Expansion

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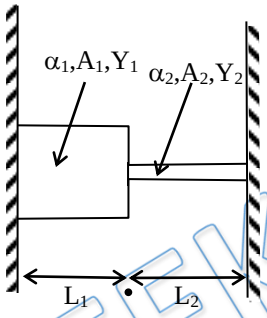
Q 1. Two elastic rods are joined between fixed supports as shown in the figure. Condition for no change in the lengths of individual rods with the increase of temperature is – (a_1,a_2 = linear expansion coefficient, A_1, A_2 = Area of rods, Y_1,Y_2 = young modulus)



(a) $\frac{A_1}{A_2} = \frac{\alpha_1 Y_1}{\alpha_2 Y_2}$ (b) $\frac{A_1}{A_2} = \frac{L_1\alpha_1 Y_1}{L_2\alpha_2 Y_2}$

(c) $\frac{A_1}{A_2} = \frac{L_2\alpha_2 Y_2}{L_1\alpha_1 Y_1}$ (d) $\frac{A_1}{A_2} = \frac{\alpha_2 Y_2}{\alpha_1 Y_1}$

Q 2. An iron tyre is to be fitted onto a wooden wheel 1.0 metre in diameter. The diameter of the tyre is 6 mm, smaller than that of the wheel. The tyre should be heated so that its temperature increases by a minimum of (given coefficient of volume expansion of iron is 3.6 x 10^{-5}/°C)

(a) 167°C (b) 334°C (c) 500°C (d) 1000°C

Q 3. When a block of iron floats in mercury at 0°C, a fraction K_1 of its volume is submerged, while at the temperature 60°C, a fraction K_2 is seen to be submerged. If the coefficient of volume expansion of iron is γ_{Fe}, and that of mercury γ_{Hg}, then the ratio K_1 / K_2 can be expressed as –

(a) $\frac{1+60\gamma_{Fe}}{1+60\gamma_{Hg}}$ (b) $\frac{1-60\gamma_{Fe}}{1+60\gamma_{Hg}}$ (c) $\frac{1+60\gamma_{Fe}}{1-60\gamma_{Hg}}$ (d) $\frac{1+60\gamma_{Hg}}{1+60\gamma_{Fe}}$

Q 4. Two rods one of aluminium and the other made of steel, having initial length l_1 and l_2 are connected together to form a single rod of length $l_1 + l_2$. The coefficients of linear expansion for aluminium and steel are a_a and a_s respectively. If the length of each rod increases by the same amount when their temperature are raised by t°C, then find the ratio $l_1/(l_1 + l_2)$ –

(a) a_s / a_a (b) a_a/a_s

(c) $a_s /(a_a + a_s)$ (d) $a_a /(a_a + a_s)$

Q 5. An iron ball is heated. The percentage increase will be the largest in –

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(a) diameter (b) surface area
(c) volume (d) density

Q 6. Two holes of unequal diameters d_1 and d_2 ($d_1 > d_2$) are cut in a metal sheet. If the sheet is heated–
(a) Both d_1 and d_2 will decrease
(b) Both d_1 and d_2 will increase
(c) d_1 will increase, d_2 will decrease
(d) d_1 will decrease, d_2 will increase

Q 7. Two rods of lengths l_1 and l_2 are made of materials whose coefficient of linear expansions are a_1 and a_2. If the difference between two lengths is independent of temperature–
(a) $\frac{\ell_1}{\ell_2} = \frac{\alpha_1}{\alpha_2}$ (b) $\frac{\ell_1}{\ell_2} = \frac{\alpha_2}{\alpha_1}$
(c) $\ell_2^2\alpha_1 = \ell_1^2\alpha_2$ (d) $\frac{\alpha_1^2}{\ell_1} = \frac{\alpha_2^2}{\ell_2}$

Q 8. Three rods of equal length are joined to form an equilateral triangle ABC. D is midpoint of AB. The coefficient of linear expansion is a_1 for AB, and a_2 for AC and BC. If the distance DC remains constant for small changes in temperature-
(a) $a_1 = a_2$ (b) $a_1 = 2a_2$
(c) $a_1 = 4a_2$ (d) $a_1 = \frac{1}{2}a_2$

Q 9. A uniform metal rod is used as a bar pendulum. If the room temperature rises by 10°C, and the coefficient of linear expansion of the metal of the rod is 2×10^{-6} per °C, the period of the pendulum will have percentage increase of-
(a) -2×10^{-3} (b) -1×10^{-3} (c) 2×10^{-3} (d) 1×10^{-3}

Q 10. A vessel is partly filled with a liquid. Coefficient of cubical expansion of material of the vessel and liquid are g_V and g_L respectively. If the system is heated, then volume unoccupied by the liquid will necessarily-
(a) Remain unchanged if $g_V = g_L$
(b) Increase if $g_V = g_L$
(c) Decrease if $g_V = g_L$
(d) None of these

Q 11. The volume of the bulb of a mercury thermometer at 0°C is V_0 and cross-section of the capillary is A_0. The coefficient of linear expansion of glass is a_g per°C and the cubical expansion of mercury g_m per °C. If the mercury just fills the bulb at 0°C, what is the length of mercury column in capillary at T°C-
(a) $\frac{V_0T(\gamma_m+3\alpha_g)}{A_0(1+2\alpha_gT)}$ (b) $\frac{V_0T(\gamma_m-3\alpha_g)}{A_0(1+2\alpha_gT)}$
(c) $\frac{V_0T(\gamma_m+2\alpha_g)}{A_0(1+3\alpha_gT)}$ (d) $\frac{V_0T(\gamma_m-2\alpha_g)}{A_0(1+3\alpha_gT)}$

Q 12. A beaker is completely filled with water at 4°C.If expansion in beacker is negligible, It must overflow –
(a) when heated but not when cooled

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(b) when cooled but not when heated
(c) both when heated or cooled
(d) neither when heated nor when cooled

Q 13. Match The Column

Column I	Column II
(A) When temperature increases then time period of pendulum [rod is of metal]	(P) Decrease
(B) When temperature decreases then time period of pendulum [rod is of metal]	(Q) Increase
(C) A cavity is inside of metal sphere then on increasing the temperature	(R) Same
(D) Radius of A hole in a circular plate on increasing temperature	(S) Can't say anything

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Answer Key

Q.1 d	**Q.2 c**	**Q.3 a**	**Q.4 c**	**Q.5 c**
Q.6 b	**Q.7 b**	**Q.8 c**	**Q.9 d**	**Q.10 b**
Q.11 b	**Q.12 c**			

Ans. 13) A $\rightarrow$ Q; B $\rightarrow$ P; C $\rightarrow$ Q; D $\rightarrow$ Q