Single Correct Answer Type:

1. A clock pendulum made of metal has a period of 0.5 sec at $20°C$. If the clock is used in a climate where the temperature is $30°C$, how much time does the clock loose in each oscillation. $\left(\alpha = 9\times10^{-7}/°C\right)$

(A) 2.25×10^{-6} sec (B) 2.5×10^{-7} sec (C) 5×10^{-7} sec (D) 1.125×10^{-6} sec

2. Two rods of length L_1 and L_2 are welded together to make a composite rod of length (L_1+L_2). If the coefficient of linear expansion of materials of rods are α_1 and α_2 respectively, the effective coefficient of linear expansion of composite rod is

(A) $\frac{L_1\alpha_1 - L_2\alpha_2}{L_1+L_2}$ (B) $\frac{L_1\alpha_1 + L_2\alpha_2}{L_1+L_2}$ (C) $\sqrt{\alpha_1\alpha_2}$ (D) $\frac{\alpha_1+\alpha_2}{2}$

3. A one litre glass flask contains some mercury. It is found that at different temperatures, the volume of air inside the flask remains the same. Volume of mercury in the flask is:
$(\alpha_{glass} = 9\times10^{-6}/°C,\ \gamma_{Hg} = 1.8\times10^{-4}/°C)$

(A) $100\,cm^3$ (B) $120\,cm^3$ (C) $150\,cm^3$ (D) $200\,cm^3$

4. The volume of a metal sphere increases by 0.24% when its temperature is raised by $40°C$. The coefficient of linear expansion of the metal is

(A) $2\times10^{-5}/°C$ (B) $6\times10^{-5}/°C$ (C) $18\times10^{-5}/°C$ (D) $1.2\times10^{-5}/°C$

5. Two rods of length L_1 and L_2 are made of materials whose coefficients of linear expansion are α_1 and α_2. If the difference between the two lengths is independent of temperature, then:

(A) $\frac{L_1}{L_2} = \frac{\alpha_1}{\alpha_2}$ (B) $\frac{L_1}{L_2} = \frac{\alpha_2}{\alpha_1}$ (C) $L_1\alpha_1^2 = L_2\alpha_2^2$ (D) $L_1^2\alpha_1 = L_2^2\alpha_2$

6. A uniform solid sphere of copper is rotating about its diameter with an angular speed w. Its temperature is increased by $80°C$. α_{cu} is the coefficient of linear expansion of cu. The new angular speed will be:

(A) $\frac{w}{1+80\alpha_{cu}}$ (B) $\frac{w}{1+160\alpha_{cu}}$ (C) $w(1+80\alpha_{cu})$ (D) $w(1+160\alpha_{cu})$

7. X is a uniform wire of length ℓ_x and radius r_x. Y is another uniform wire of same material of length ℓ_y and radius r_y. Both wires are given equal amount of heat. If $\ell_x = \ell_y$, but $r_x < r_y$.

(A) X expands more than Y (B) X expands less than Y
(C) X expands as much as Y (D) None of the above

8. Two metal strips that constitute a thermostat must necessarily differ in their

(A) length (B) mass (C) resistivity (D) Coefficient of linear expansion

9. Coefficient of apparent expansion of mercury in a glass vessel is $1.53\times10^{-4}/°C$ and steel vessel is $1.44\times10^{-4}/°C$. If α for the steel is $1.2\times10^{-5}/°C$, then that of glass is

(A) $3.5\times10^{-5}/°C$ (B) $6\times10^{-6}/°C$ (C) $2.7\times10^{-5}/°C$ (D) $9\times10^{-6}/°C$

10. Coefficient of linear expansion of an isotropic solid along three rectangular axes in the solid are α_x, α_y and α_z. The coefficient of cubical expansion of the solid for small change in temperature can be expressed as (assume α_x, α_y and α_z are small)

(A) $\alpha_x+\alpha_y+\alpha_z$ (B) $\alpha_x\alpha_y\alpha_z$ (C) $\sqrt{\alpha_x^2+\alpha_y^2+\alpha_z^2}$ (D) $\frac{\alpha_x+\alpha_y+\alpha_z}{3}$

11. If the length of a cylinder on heating increase by 2% the area of its base will increase by
(A) 0.5% (B) 2% (C) 1% (D) 4%

12. When a block of iron floats in mercury at $0°C$, 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 is γ_{Hg}, then the ration 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) $\frac{1+60\gamma_{Hg}}{1+60\gamma_{Fe}}$

13. Two rods, one of aluminium and the other made of steel, having initial lengths 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 α_A and α_S, respectively. If the length of each rod increases by the same amount when their temperatures are raised by $t°C$, then find the ratio $\frac{l_1}{l_1+l_2}$

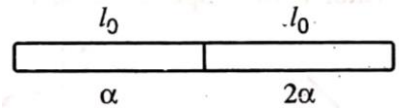
(A) α_S/α_A (B) α_A/α_S (C) $\alpha_S/(\alpha_A+\alpha_S)$ (D) $\alpha_A/(\alpha_A+\alpha_S)$

14. Coefficients of apparent expansion of a liquid when it is determined using two different vessels A and B are γ_1 and γ_2 respectively. If the coefficient of linear expansion of the vessel A is α, coefficient of linear expansion of B is :

(A) $\frac{\gamma_1\gamma_2}{\alpha(\gamma_1+\gamma_2)}$ (B) $\frac{\gamma_1-\gamma_2}{3}+\alpha$ (C) $\frac{\gamma_1-\gamma_2}{3\alpha}$ (D) $\frac{\gamma_1+\gamma_2}{3\alpha}$

15. There are two spheres of same material and radius. One is solid and the other is hollow. If they are heated to the same temperature the expansion of:
(A) solid sphere is more (B) hollow sphere is more
(C) solid and hollow spheres are equal (D) solid is outwards while that of hollow is inwards

16. Two uniform rods of equal length (l_0) and equal masses having coefficient of linear expansion α and 2α are placed in contact on a smooth horizontal surface as shown. The temperature of system is $\theta°C$. Now the temperature is increased by $\Delta\theta°C$. The junction of the rods will shift from its initial position by:



Initial temperature $= \theta°C$

(A) $\frac{l_0\alpha\Delta\theta}{2}$ (B) $\frac{l_0\alpha\Delta\theta}{3}$ (C) $\frac{l_0\alpha\Delta\theta}{4}$ (D) $\frac{l_0\alpha\Delta\theta}{6}$

17. The coefficient of linear expansion of an inhomogeneous rod changes linearly from α_1 to α_2, from one end to the other end of the rod. The effective coefficient of linear expansion of the rod is :

(A) $\alpha_1+\alpha_2$ (B) $\frac{\alpha_1+\alpha_2}{2}$ (C) $\sqrt{\alpha_1\alpha_2}$ (D) $\sqrt{\alpha_1-\alpha_2}$

18. A brass wire 1.8 m long at $27°C$ is held taut with negligible tension between two rigid supports. Diameter of the wire is 2 mm, its coefficient of linear expansion, $\alpha_{Brass}=2\times10^{-5}/°C$ and its Young's modulus, $Y_{Brass}=9.1\times10^{10}N/m^2$. If the wire is cooled to a temperature $-39°C$, tension developed in it is nearly:
(A) 380 N (B) 420 N (C) 510 N (D) 125 N

19. 'A' is a steel rod of length l_A and 'B' is a copper rod of length l_B. Values of l_A and l_B such that $l_A-l_B=5cm$ at all temperatures, are:
(Given $\alpha_{Cu}=1.7\times10^{-5}/°C$, $\alpha_{Steel}=1.1\times10^{-5}/°C$)
(A) 21.4 cm, 16.4 cm (B) 10.8 cm, 5.8 cm (C) 14.2 cm, 9.2 cm (D) 32.4 cm, 27.4 cm

20. It is required to prepare a steel metre scale such that the millimetre intervals are to be accurate within 0.0005 mm at a certain temperature. Maximum temperature variation allowable during the rulings of millimetre marks is:
($\alpha_{Steel} = 13.22 \times 10^{-6}/°C$)
(A) 37.8°C (B) 45.4°C (C) 10.2°C (D) 62.6°C

Numerical based:

21. The ratio of lengths of two rods is 1:2 and ratio at coefficient of expansion is 2:3. The first rod is heated through $60°C$. The temperature through which the second rod is to be heated so that its expansion is twice that of first is $x \times 10^2 °C$. Find the value of x.

22. Two uniform brass rods A and B of lengths ℓ and 2ℓ and radii 2r and r respectively are heated to the same temperature. The ratio of the increase in the volume of A to that of B is $\frac{1}{P}$. Find value of P.

23. If the volume of a block of metal changes by 0.12%. When temperature is changed from $40°C$ to $60°C$. The linear coefficient of expansion is ____ $\times 10^{-5}/K$.

24. A solid ball is completely immersed in a liquid. The coefficient of volume expansion of the ball and liquid are 3×10^{-6} and $8 \times 10^{-6}/°C$ respectively. The percentage change in upthrust when the temperature is increased by $100°C$ is _____ %.

25. A metallic sphere (with $\alpha = 2 \times 10^{-6}/°C$) of radius 10 cm is heated at the rate of $2°C/Sec$. Its volume will increase at the rate of _____ $\times \pi \times 10^{-2} cm^3/s$.

KEY

1.	A	2.	B	3.	C	4.	A	5.	B
6.	B	7.	A	8.	D	9.	D	10.	A
11.	D	12.	A	13.	C	14.	B	15.	C
16.	C	17.	B	18.	A	19.	C	20.	A
21.	0.40	22.	0.50	23.	2	24.	0.05	25.	1.60