1. Expansion during heating

(a) Occurs only in solids

(b) Increases the weight of a material

(c) Decreases the density of a material

(d) Occurs at the same rate for all liquids and solids

2. When a rod is heated but prevented from expanding, the stress developed is independent of

(a) Material of the rod (b) Rise in temperature

(c) Length of rod (d) None of above

3. Ratio among linear expansion coefficient (α), areal expansion coefficient (β) and volume expansion coefficient (γ) is

(a) 1 : 2 : 3 (b) 3 : 2 : 1

(c) 4 : 3 : 2 (d) None of these

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 ..... °*C*

(a) 2×10^{-5} (b) 6×10^{-5}

(c) 2.1×10^{-5} (d) 1.2×10^{-5}

5. Water has maximum density at

(a) 0°*C* (b) 32°*F*

(c) – 4°*C* (d) 4°*C*

6. A bar of iron is 10 *cm* at 20°*C*. At 19°*C* it will be (α of iron = 11×10^{-6}/°*C*)

(a) 11×10^{-6} *cm* longer (b) 11×10^{-6} *cm* shorter

(c) 11×10^{-5} *cm* shorter (d) 11×10^{-5} *cm* longer

7. A vertical column 50 *cm* long at 50°*C* balances another column of same liquid 60 *cm* long at 100°*C*. The coefficient of absolute expansion of the liquid is

(a) 0.005/°*C* (b) 0.0005/°*C*

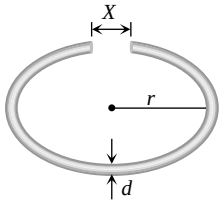
(c) 0.002/°*C* (d) 0.0002/°*C*

8. An iron bar of length 10 *m* is heated from 0°*C* to 100°*C*. If the coefficient of linear thermal expansion of iron is 10×10^{-6} /°*C*, the increase in the length of bar is

(a) 0.5 *cm* (b) 1.0 *cm*

(c) 1.5 *cm* (d) 2.0 *cm*

9. A cylindrical metal rod of length L_0 is shaped into a ring with a small gap as shown. On heating the system



(a) *x* decreases, *r* and *d* increase

(b) x and r increase, d decreases
(c) x, r and d all increase
(d) Data insufficient to arrive at a conclusion

10. Surface of the lake is at $2°C$. Find the temperature of the bottom of the lake
(a) $2°C$ (b) $3°C$
(c) $4°C$ (d) $1°C$

11. When a copper ball is heated, the largest percentage increase will occur in its
(a) Diameter (b) Area
(c) Volume (d) Density

12. The apparent coefficient of expansion of a liquid when heated in a copper vessel is C and when heated in a silver vessel is S. If A is the linear coefficient of expansion of copper, then the linear coefficient of expansion of silver is
(a) $\frac{C+S-3A}{3}$ (b) $\frac{C+3A-S}{3}$
(c) $\frac{S+3A-C}{3}$ (d) $\frac{C+S+3A}{3}$

13. On heating a liquid of coefficient of cubical expansion γ in a container having coefficient of linear expansion $\gamma/3$, the level of liquid in the container will
(a) Rise
(b) Fall
(c) Will remain almost stationary
(d) It is difficult to say

14. A metal rod of silver at $0°C$ is heated to $100°C$. It's length is increased by 0.19 cm. Coefficient of cubical expansion of the silver rod is
(a) $5.7 \times 10^{-5}/°C$ (b) $0.63 \times 10^{-5}/°C$
(c) $1.9 \times 10^{-5}/°C$ (d) $16.1 \times 10^{-5}/°C$

15. The length of a metallic rod is $5m$ at $0°C$ and becomes 5.01 m, on heating upto $100°C$. The linear expansion of the metal will be
(a) $2.33 \times 10^{-5}/°C$ (b) $6.0 \times 10^{-5}/°C$
(c) $4.0 \times 10^{-5}/°C$ (d) $2.0 \times 10^{-5}/°C$

16. A pendulum clock keeps correct time at $0°C$. Its mean coefficient of linear expansions is $\alpha/°C$, then the loss in seconds per day by the clock if the temperature rises by $t°C$ is
(a) $\frac{\frac{1}{2}\alpha t \times 864000}{1-\frac{\alpha t}{2}}$ (b) $\frac{1}{2}\alpha t \times 86400$
(c) $\frac{\frac{1}{2}\alpha t \times 86400}{\left(1-\frac{\alpha t}{2}\right)^2}$ (d) $\frac{\frac{1}{2}\alpha t \times 86400}{1+\frac{\alpha t}{2}}$

17. In cold countries, water pipes sometimes burst, because

(a) Pipe contracts
(b) Water expands on freezing
(c) When water freezes, pressure increases
(d) When water freezes, it takes heat from pipes

18. When a bimetallic strip is heated, it
(a) Does not bend at all
(b) Gets twisted in the form of an helix
(c) Bend in the form of an arc with the more expandable metal outside
(d) Bends in the form of an arc with the more expandable metal inside

19. 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}

20. If on heating liquid through 80°*C*, the mass expelled is $(1/100)^{th}$ of mass still remaining, the coefficient of apparent expansion of liquid is
(a) $1.25 \times 10^{-4}/°C$ (b) $12.5 \times 10^{-4}/°C$
(c) $1.25 \times 10^{-5}/°C$ (b) None of these

21. A brass disc fits simply in a hole of a steel plate. The disc from the hole can be loosened if the system
(a) First heated then cooled (b)First cooled then heated
(c) Is heated (d) Is cooled

22. The real coefficient of volume expansion of glycerine is 0.000597 per°*C* and linear coefficient of expansion of glass is 0.000009 per°*C*. Then the apparent volume coefficient of expansion of glycerine is
(a) 0.000558 per°*C* (b) 0.00057 per°*C*
(c) 0.00027 per°*C* (d) 0.00066 per°*C*

23. Coefficient of real expansion of mercury is $0.18 \times 10^{-3}/°C$. If the density of mercury at 0°*C* is 13.6 *gm/cc*. its density at 473*K* is
(a) 13.11 *gm/cc* (b) 26.22 *gm/cc*
(c) 52.11 *gm/cc* (d) None of these

24. A beaker is completely filled with water at 4°*C*. It will overflow if
(a) Heated above 4°*C*
(b) Cooled below 4°*C*
(c) Both heated and cooled above and below 4°*C* respectively
(d) None of the above

25. The volume of a gas at 20°*C* is 100 cm^3 at normal pressure. If it is heated to 100°*C*, its volume becomes 125 cm^3 at the same pressure, then volume coefficient of the gas at normal pressure is
(a) 0.0015/°*C* (b) 0.0045/°*C*
(c) 0.0025/°*C* (d) 0.0033/°*C*

26. The coefficient of superficial expansion of a solid is 2×10^{-5}/°C. It's coefficient of linear expansion is

(a) $4 \times 10^{-5}/°C$ (b) $3 \times 10^{-5}/°C$

(c) $2 \times 10^{-5}/°C$ (d) $1 \times 10^{-5}/°C$

27. Two rods, one of aluminum 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 aluminum and steel are α_a and α_s respectively. If the length of each rod increases by the same amount when their temperature are raised by t^oC, then find the ratio $\frac{l_1}{(l_1 + l_2)}$

(a) $\frac{\alpha_s}{\alpha_a}$ (b) $\frac{\alpha_a}{\alpha_s}$

(c) $\frac{\alpha_s}{(\alpha_a + \alpha_s)}$ (d) $\frac{\alpha_a}{(\alpha_a + \alpha_s)}$

28. At some temperature *T*, a bronze pin is a little large to fit into a hole drilled in a steel block. The change in temperature required for an exact fit is minimum when

(a) Only the block is heated

(b) Both block and pin are heated together

(c) Both block and pin are cooled together

(d) Only the pin is cooled

29. Density of substance at 0°*C* is 10 *gm/cc* and at 100°*C*, its density is 9.7 *gm/cc*. The coefficient of linear expansion of the substance will be

(a) 10^2 (b) 10^{-2}

(c) 10^{-3} (d) 10^{-4}

30. 5 *litre* of benzene weighs

(a) More in summer than in winter

(b) More in winter than in summer

(c) Equal in winter and summer

(d) None of the above

31. A *litre* of alcohol weighs

(a) Less in winter than in summer

(b) Less in summer than in winter

(c) Some both in summer and winter

(d) None of the above

32. If a cylinder of diameter 1.0 *cm* at 30°*C* is to be solid into a hole of diameter 0.9997 *cm* in a steel plate at the same temperature, then minimum required rise in the temperature of the plate is : (Coefficient of linear expansion of steel $= 12 \times 10^{-6}/°C$)

(a) 25°*C* (b) 35°*C*

(c) 45°*C* (d) 55°*C*

33. A solid ball of metal has a concentric spherical cavity within it. If the ball is heated, the volume of the cavity will

(a) Increase (b) Decrease

(c) Remain unaffected (d) None of these

34. If the length of a cylinder on heating increases by 2%, the area of its base will increase by

(a) 0.5% (b) 2%

(c) 1% (d) 4%

1. (c) Solids, liquids and gases all expand on being heated as result density (= mass/volume) decreases.

2. (c) Stress $= Y\alpha\Delta\theta$; hence it is independent of length.

3. (a) As $\alpha = \frac{\beta}{2} = \frac{\gamma}{3} \Rightarrow \alpha : \beta : \gamma = 1 : 2 : 3$

4. (a) $\gamma = \frac{\Delta V}{V.\Delta T} = \frac{0.24}{100 \times 40} = 6 \times 10^{-5} / °C$

$\Rightarrow \alpha = \frac{\gamma}{3} = 2 \times 10^{-5} / °C$

5. (d) Water has maximum density at 4°*C*.

6. (c) $L = L_0(1 + \alpha\Delta\theta) \Rightarrow \frac{L_1}{L_2} = \frac{1 + \alpha(\Delta\theta)_1}{1 + \alpha(\Delta\theta)_2}$

$\Rightarrow \frac{10}{L_2} = \frac{1 + 11 \times 10^{-6} \times 20}{1 + 11 \times 10^{-6} \times 19} \Rightarrow L_2 = 9.99989$

$\Rightarrow$ Length is shorten by

$10 - 9.99989 = 0.00011 = 11 \times 10^{-5}\ cm$

7. (a) $\frac{h_1}{h_2} = \frac{\rho_1}{\rho_2} = \frac{(1 + \gamma\theta_1)}{(1 + \gamma\theta_2)} \quad \left[\because \rho = \frac{\rho_0}{(1 + \gamma\theta)}\right]$

$\Rightarrow \frac{50}{60} = \frac{1 + \gamma \times 50}{1 + \gamma \times 100} \Rightarrow \gamma = 0.005 / °C$

8. (b) Increase in length $\Delta L = L_0\ \alpha\ \Delta\theta$

$= 10 \times 10 \times 10^{-6} \times (100 - 0) = 10^{-2}\ m = 1\ cm$

9. (c) On heating the system; *x*, *r*, *d* all increases, since the expansion of isotropic solids is similar to true photographic enlargement.

10. (c) The densest layer of water will be at bottom. The density of water is maximum at 4°*C*. So the temperature of bottom of lake will be 4°*C*.

11. (c) When a copper ball is heated, it's size increases. As Volume ∝(radius)^3 and Area ∝ ((radius)^2, so percentage increase will be largest in it's volume. Density will decrease with rise in temperature.

12. (b) $\gamma_r = \gamma_a + \gamma_v$; where $\gamma_r =$ coefficient of real expansion, $\gamma_a =$ coefficient of apparent expansion and $\gamma_v =$ coefficient of expansion of vessel.

For copper $\gamma_r = C + 3\alpha_{Cu} = C + 3A$

For silver $\gamma_r = S + 3\alpha_{Ag}$

$\Rightarrow C + 3A = S + 3\alpha_{Ag} \Rightarrow \alpha_{Ag} = \frac{C - S + 3A}{3}$

13. (c) As coefficient of cubical expansion of liquid equals coefficient of cubical expansion of vessel, the level of liquid will not change on heating.

14. (a) $\alpha = \frac{\Delta L}{L_0(\Delta\theta)} = \frac{0.19}{100\ (100-0)} = 1.9\times10^{-5}\ /°C$

Now $\gamma = 3\alpha = 3 \times 1.9 \times 10^{-5}/°C = 5.7 \times 10^{-5}/°C$

15. (d) $\alpha = \frac{\Delta L}{L_0 \times \Delta\theta} = \frac{0.01}{5\times100} = 2\times10^{-5}\ /°C$

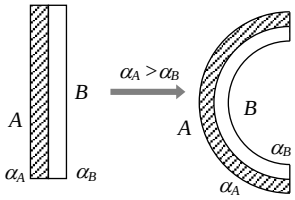
16. (b) Loss in time per second $\frac{\Delta T}{T} = \frac{1}{2}\alpha\Delta\theta = \frac{1}{2}\alpha(t-0)$

$\Rightarrow$ loss in time per day

$\Delta t = \left(\frac{1}{2}\alpha t\right)t = \frac{1}{2}\alpha t \times (24\times60\times60) = \frac{1}{2}\alpha t \times 86400$

17. (b) In anomalous expansion, water contracts on heating and expands on cooling in the range $0°C$ to $4°C$. Therefore water pipes sometimes burst, in cold countries.

18. (c) A bimetallic strip on being heated bends in the form of an arc with more expandable metal (A) outside (as shown) correct.



19. (d) Fractional change in period

$\frac{\Delta T}{T} = \frac{1}{2}\alpha\Delta\theta = \frac{1}{2}\times2\times10^{-6}\times10 = 10^{-5}$

% change $= \frac{\Delta T}{T}\times100 = 10^{-5}\times100 = 10^{-3}\ \%$

20. (a) $\gamma_{app.} = \frac{\text{Mass expelled}}{\text{Mass remained} \times \Delta T}$

$= \frac{x/100}{x\times80} = \frac{1}{8000} = 1.25\times10^{-4}\ /°C$

21. (d) Since, the coefficient of linear expansion of brass is greater than that of steel. On cooling, the brass contracts more, so, it get loosened.

22. (b) As we know $\gamma_{real} = \gamma_{app.} + \gamma_{vessel}$

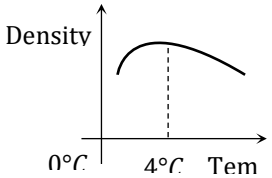
$\Rightarrow \gamma_{app.} = \gamma_{glycerine} - \gamma_{glass}$

$= 0.000597 - 0.000027 = 0.00057\ /°C$

23. (a) $\rho = \rho_0(1-\gamma.\Delta\theta) = 13.6[1-0.18\times10^{-3}(473-273)]$

$= 13.6[1-0.036] = 13.11\ gm/cc$.

24. (c) Water has maximum density at $4°C$, so if the water is heated above $4°C$ or cooled below $4°C$ density decreases *i.e.* volume increases. In other words, it expands so it overflows in both the cases.



25. (d) $\frac{V_1}{V_2} = \frac{1+\gamma t_1}{1+\gamma t_2} \Rightarrow \frac{100}{125} = \frac{1+\gamma \times 20}{1+\gamma \times 100} \Rightarrow \gamma = 0.0033/°C$

26. (d) $\alpha = \frac{\beta}{2} = \frac{2\times10^{-5}}{2} = 10^{-5}/°C$

27. (c) Given $\Delta l_1 = \Delta l_2$ or $l_1\alpha_a t = l_2\alpha_s t$

$\therefore \frac{l_1}{l_2} = \frac{\alpha_s}{\alpha_a}$ or $\frac{l_1}{l_1+l_2} = \frac{\alpha_s}{\alpha_a+\alpha_s}$.

28. (a) Since coefficient of expansion of steel is greater than that of bronze. Hence with small increase in it's temperature the hole expand sufficiently.

29. (d) Coefficient of volume expansion

$\gamma = \frac{\Delta\rho}{\rho.\Delta T} = \frac{(\rho_1-\rho_2)}{\rho.(\Delta\theta)} = \frac{(10-9.7)}{10\times(100-0)} = 3\times10^{-4}$

Hence, coefficient of linear expansion

$\alpha = \frac{\gamma}{3} = 10^{-4}/°C$

30. (b) Similar to previous question, benzene contracts in winter. So 5 litre of benzene will weigh more in winter than in summer.

31. (b) In summer alcohol expands, density decreases, so 1 litre of alcohol will weigh less in summer than in winter.

32. (a) $\alpha = \frac{\Delta L}{L_0\Delta\theta} = \frac{(1-0.9997)}{0.9997\times12\times10^{-6}} = 25°C$

33. (a) When the ball is heated, expansion of ball and cavity both occurs, hence volume of cavity increases.

34. (d) $A \propto L^2 \Rightarrow \frac{\Delta A}{A} = 2\cdot\frac{\Delta L}{L} \Rightarrow \frac{\Delta A}{A} = 2\times2 = 4\%$.