CHAPTER THIRTEEN

LINEAR EXPANSION

Coefficient if linear expansion:

- The coefficient of linear expansion or the coefficient of linear expansivity of a substance is defined as the increase in its length per unit length of the substance, for each degree Kelvin rise in temperature.

$$\propto = \frac{Expansion}{Original\ length \times change\ in\ temperature}$$

$$=> \propto = \frac{e}{L_1 \times \triangle T}$$

$$=> \propto = \frac{L_2 - L_1}{L_1(\theta_2 - \theta_1)}$$

where L_1 = initial length.

L_2 = final length.

θ_1 = initial temperature.

θ_2 = final temperature.

The following must also be taken notice of:

(1) e = $\propto L_1(\theta_2 - \theta_1)$
(2) $L_2 = L_1 + \propto L_1(\theta_2 - \theta_1)$
(3) $L_2 = L_1 [1 + \propto (\theta_2 - \theta_1)]$.

Area or superficial expansion:

- This is the increase in the area of a body with temperature change.
- A sheet of metal expands throughout its area, when the temperature is increased over a period of time.

- The area or superficial expansivity, β = $\frac{Change\ in\ area}{Original\ area \times temperature\ change.}$

- Also β = $\frac{A_2 - A_1}{A_1(\theta_2 - \theta_1)}$, where

(1) A_1 = the original area before the increase in temperature.

If L_1 = the original length before the rise in temperature and b_1 = the original breadth before the rise in temperature then A_1 = L_1 X b_1.

(2) A_2 = Final area after the rise in temperature.

- A_2 = L_2 X b_2, where L_2 = the final length after the rise in temperature, and b_2 = the final breadth after the rise in temperature.

(3) θ_2 = the final temperature after the rise in temperature and θ_1 = the initial temperature before the rise in temperature.

- *The superficial expansivity is* β = 2$\propto$, which isapproximately two times the linear expansivity i.e. β = 2$\propto$.
- In short for superficiall expansivity β = 2$\propto$.
- Also$\beta = \frac{\triangle A}{A_0 \triangle \theta}$, where $\triangle$A = change in area, A_0 = the original area and $\triangle\theta$ = the change in temperature.

(Q1) The coefficient of linear expansivity of a metal is 2.7 x $10^{-5}k^{-1}$. If its original area is $600mm^2$, what will be the change in its area if it's temperature changes from 60^0c to 80^0C ?

N/B:

Use β = 2$\propto$= 2(2.7 x 10^{-5}) and $\triangle$A = change in area.

Soln:

$\propto = 2.7 \text{ x } 10^{-5}$

$=> \beta = 2\propto = 2 \text{ x } 2.7 \text{ x } 10^{-5}$,

$=> \beta = 5.4 \text{ x } 10^{-5} = 5.4 \text{ x } 10^{-5}k^{-1}$

$A_0 = 600mm^2$ and $\triangle\theta = 80 - 60 = 20^0C$.

But β= $\frac{\triangle A}{A_0 \triangle \theta}$, where $\triangle$A = change in area,

$\Rightarrow 5.4 \times 10^{-5} = \frac{\triangle A}{600 \times 20}$

$\Rightarrow 5.4 \times 10^{-5} = \frac{\triangle A}{12000},$

$\Rightarrow \triangle A = 5.4 \times 10^{-5} \times 12000$

$= 5.4 \times 10^{-5} \times 12 \times 10^{3}$

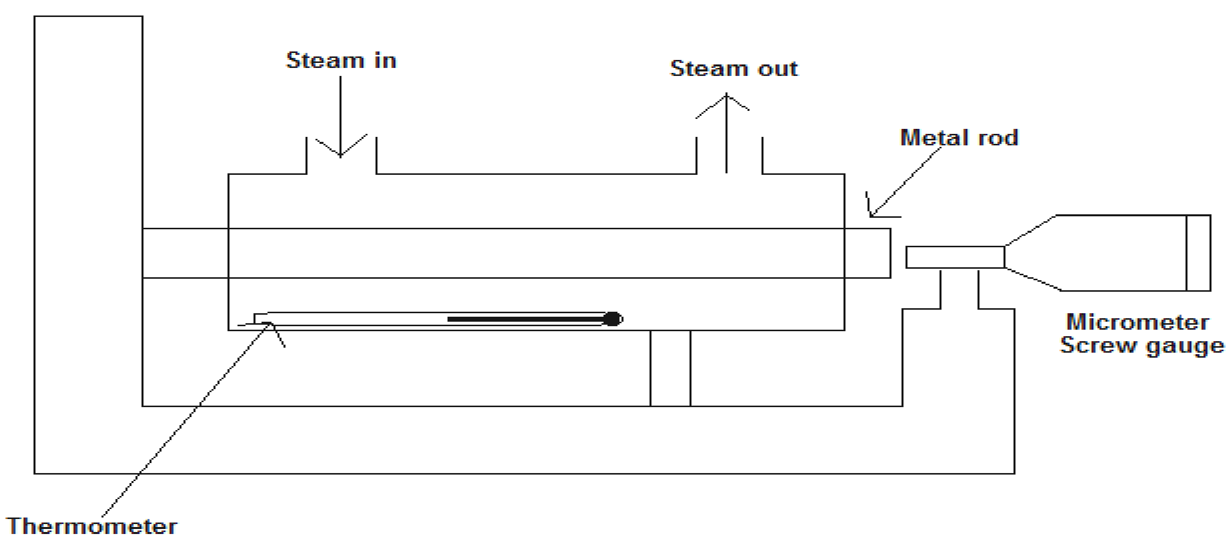
$= 5.4 \times 12 \times 10^{-5} \times 10^{3}$

$= 64.8 \times 10^{-2} = 64.8 \times \frac{1}{100}$

$\Rightarrow \triangle A = 0.64mm^2.$

△

Experiment to determine the linear expansivity of a metal rod:



Experiment to determine the linear expansivity of a metal rod:

Procedure:

(1) The metal rod of known length is placed in a chamber, as shown in the given diagram.
(2) Its initial temperature is taken.
(3) Steam is then passed through the chamber until the thermometer reading is steady, and this steady temperature is noted.

(4) The micrometer is then screwed in to make contact with the rod, and its final temperature is needed.

<u>Data:</u>

Initial length of rod = L_0.

Initial temperature of rod = θ_1.

Initial micrometer reading = L_2.

Final micrometer reading = L_3.

Final temperature of rod = θ_2.

<u>Calculation:</u>

Rise in temperature = $\theta_2 - \theta_1$.

Increase in length of rod = $L_3 - L_2$.

Linear expansivity = $\frac{\text{change in length}}{Original\ length \times temperature\ change.}$

$=> \propto = \frac{\mathrm{L3 - L2}}{L_0(\theta_2 - \theta_1)}$.

Precaution: The micrometer should be unscrewed again and the steam flow continued for a few minutes. A final reading of the micrometer is taken in order to be certained whether or not the rod had fully acquired the steam temperature in the first instance.

(Q2) In the determination of the linear expansion of a brass rod, the following results were obtained. Original length of rod brass = 50.2cm.

Initial temperature of the rod = 16.6^0C.

Final temperature of the rod = 99.5^0C.

1^{st} micrometer reading = 3.48mm.

2^{nd} micrometer reading = 4.27mm.

Calculate the coefficient of linear expansion of the rod.

Soln:

Rise in temperature of the rod = 99.5 – 16.6 = 82.9^{0}C.

Expansion = 4.27 – 3.48 = 0.79mm = $\frac{0.79}{10} = 0.079cm$.

Coefficient of linear expansion = $\frac{Expansion}{Original\ length \times rise\ in\ temperature}$

= $\frac{0.079}{50.2 \times 82.9} = 0.000019/^0$C.

N/B: The original length of the rod is given in centimetre and the expansion is in millimetres. The millimetres must be converted into centimetres by dividing by 10.

Equation for expansion:

- Suppose L_1 = the original length of a rod of the material and $\propto$ = the coefficient of linear expansion for the material, then for a rise θ in temperature, the expansion = $L_1 \propto \theta$.
- The new length, $L_2 =$ the original length $+$ expansion, i.e. $L_2 = L_1 + L_1 \propto \theta$

$=> L_2 = L_1 (1 + \propto \theta)$.

(Q3) Calculate the expansion of a 15m copper pipe, when it is heated from 5^{0}C to 60^{0}C, if the linear expansivity of copper = 0.000012k^{-1}.

Soln:

Original length = L_1 = 15m.

Initial temperature = θ_1 = 5^{0}C.

Final temperature = θ_2 = 60^{0}C.

Linear expansivity of copper = $\propto = 0.000012k^{-1}$.

$e =$ expansion $=?$

But since $\propto = \frac{e}{l_1(\theta_2 - \theta_1)}$

$=> 0.000012 = \frac{e}{15(60-5)}$,

$=> 0.000012 = \frac{e}{15 \times 55}$

$=> 0.000012 = \frac{e}{825}$

$=> e = 0.000012 \times 825$

=> e = 9.9×10^{-3} = 0.0099m.

(Q4) The coefficient of linear expansion of iron is $0.000012k^{1}$.

(a) Explain the meaning of this statement.
(b) Calculate the superficial expansion of the iron.
(c) Determine the cubical expansion of the iron.

Soln:

(a) It means that the fraction of the original length by which a rod of iron will expand per Kelvin rise in temperature, is 0.000012.
(b) Linear expansivity = $\propto$ = $1.2 \times 10^{-5}k^{-1}$. (i.e. $0.000012k^{-1}$).
But $\beta = 2\propto = 2 \times 1.2 \times 10^{-5}$,
=> $\beta = 2.4 \times 10^{-5}k^{-1}$.

(c) For cubical expansion, $Y = 3\propto = 3 \times 1.2 \times 10^{-5} = 3.6 \times 10^{-5}$.

(Q5) A metal rod has a length of 99.4cm at 200^0C. At what temperature will its length be 100cm, if the linear expansivity of the metal is $0.000021k^{-1}$.

N/B: The lengths given in centimetres must be converted into metres by dividing it by 100.

Soln:

Original length = $L_1 = 99.4\text{cm} = \frac{99.4cm}{100} = 0.994m$.

Final length = $L_2 = 100\text{cm} = \frac{100cm}{100} = 1m$.

Initial temperature = $\theta_1 = 200^0$C.

Final temperature = $\theta_2 =$?

Linear expansivity $= \propto = 2.1 \times 10^{-5}k^{-1}$.

But since $\propto = \frac{l_2 - l_1}{l_1(\theta_2 - \theta_1)}$

$=> 2.1 \times 10^{-5} = \frac{1-0.994}{0.994(\theta_2 - 200)}$,

$=> 0.000021 = \frac{0.006}{0.994(\theta_2 - 200)}$

$=> 0.000021 \times 0.994(\theta - 200) = 0.006$,

$=> 0.000021(\theta - 200) = \frac{0.006}{0.994}$,

$=> 2.1 \times 10^{-5}(\theta_2 - 200) = 0.006$,

$=> \theta_2 - 200 = \frac{0.006}{2.1 \times 10^{-5}}$

$=> \theta_2 - 200 = \frac{0.006}{2.1} \times 10^5$

$=> \theta_2 - 200 = \frac{600}{2.1}$

$=> \theta_2 - 200 = 286$

$=> \theta_2 = 286 + 200 = 486^0C$.

(Q6) The length of a wire at a temperature of 30.0^0C is 1.002m. If the temperature of the wire is raised to 105.0^0C and the linear expansivity of the wire is $1.89 \times 10^{-5}k^{-1}$, find the increase in the length of the wire.

Soln:

$L_1 = 1.002m$, $\theta_2 = 105^0C$, $\theta_1 = 30^0C$, $\propto = 1.89 \times 10^{-5}k^{-1}$,

But since $\propto = \frac{l_2 - l_1}{l_1(\theta_2 - \theta_1)} => l_2 - l_1 = \propto l_1(\theta_2 - \theta_1)$, but since $l_2 - l_1 = e$

$=> e = \propto l_1(\theta_2 - \theta_1)$,

$=> e = 1.89 \times 10^{-5} \times 1.002(105 - 30)$,

$=> e = 1.89 \times 1.002 \times 10^{-5} \times 75$,

$=> e = 1.89 \times 1.002 \times 75 \times 10^{-5}$,

$=> e = 142.034 \times 10^{-5}$,

$=> e = 142 \times 10^{-5}$

$=> e = 142 \times 10^{-2} \times 10^{-3}$,

$=> e = 142 \times \frac{1}{10^2} \times 10^{-3}$

$=> e = \frac{142}{100} \times 10^{-3}$

$=> e = 1.42 \times 10^{-3}$m.

(Q7) A telegraph wire, 50.0m long is made of a material whose linear expansivity is $2.0 \times 10^{-5}k^{-1}$. Determine the change in the length of the wire, if the temperature changes from 40^0C to -10^0C.

Soln:

$\propto = 2 \times 10^{-5}k^{-1}$.

$(\theta_2 - \theta_1)$ = change in temperature = 40 – (-10) = 40 + 10 = 50k (i.e. rise in temperature).

Initial length = L_1 = 50m.

Final length = L_2.

From $\propto = \frac{l_2 - l_1}{l_1(\theta_2 - \theta_1)}$

$=> l_2 - l_1 = \propto l_1(\theta_2 - \theta_1)$, where $l_2 - l_1$ = change in length of the wire or the expansion. But since expansion $(l_2 - l_1) = L_1 \propto \theta$, where θ = rise in temperature and L_1 = initial length of wire,

$=> L_2 - L_1 = 50 \times 2 \times 10^{-5} \times 50$,

$=> L_2 - L_1 = 2 \times 50 \times 50 \times 10^{-5}$,

$=> L_2 - L_1 = 5000 \times 10^{-5} = 5000 \times \frac{1}{10^5}$

$= \frac{5000}{100000} = 0.05m.$

=> $L_2 - L_1$ = change in length = 0.05m.

(Q8) Steel bars, each of length 3m at 39^0C are used for the construction of a rail line. If the linear expansivity of steel is 1.0 x $10^{-5}K^{-1}$, calculate the safety gap that must be allowed or left between successive bars, if the highest temperature expected is 41^0c.

Soln:

Linear expansivity = $\propto$ = 1.0 x $10^{-5}k^{-1}$.

Original length = L_1 = 3m.

Initial temperature = $\theta_1 = 39^0$c.

Final temperature = $\theta_2 = 41^0$C.

From $\propto = \frac{L_2 - L_1}{L_1(\theta_2 - \theta_1)}$

=> $L_2 - L_1 = \propto l_2(\theta_2 - \theta_1)$, where $l_2 - l_1$ = the change in length = the safety gap.

=> Safety gap = 1.0 x 10^{-5} x 3(41 – 39)

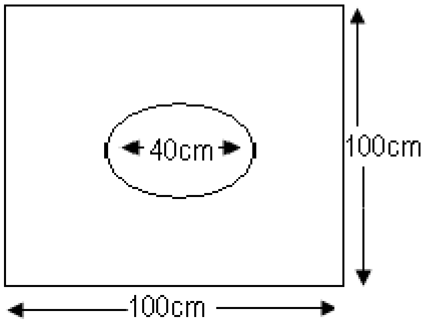
= 1.0 x 10^{-5} x 3 x 2 = 6 x 10^{-5}

= 6.0 x 10^{-5}m.

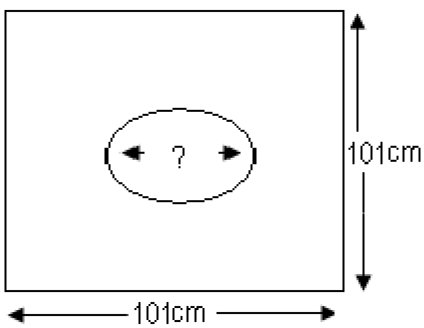
(Q9) A square metal plate, each side 100cm long at 0^0C, has a circular hole of diameter 40cm in the middle of it. At what temperature will the side be 101cm long, and what will be the diameter of the hole. [Coefficient of linear expansivity of the metal = 0.0000125k^{-1}].

Soln:

Conditions at $\theta_1 = 0^0$C



Conditions at θ_2 =?



Initial length of side = $L_1 = 100\text{cm} = \frac{100}{100} = 1m.$

Final length of side = $L_2 = 101\text{cm} = \frac{101}{100} = 1.01\text{m}.$

Initial temperature = $\theta_1 = 0^0$C.

Final temperature = $\theta_2 = ?$

Since coefficient of linear expansivity = $\propto = \frac{l_2 - l_1}{l_1(\theta_2 - \theta_1)}$

$=> 0.0000125 = \frac{1.01-1}{1(\theta_2 - 0)},$

$=> 0.0000125 = \frac{0.01}{\theta_2}$

$=> 0.0000125\theta_2 = 0.01,$

$=> \theta_2 = \frac{0.01}{0.0000125}, = 800^0C.$

The required temperature therefore = 800^0C.

(b)Let the original diameter = D_1 = 40cm = 0.4m.

Let the final diameter = D_2 =?

But since $L_2 = L_1 (1 + \propto \triangle \theta)$.

=> $D_2 = D_1 (1 + \propto \triangle \theta)$, where $\triangle \theta = 800^0C - 0^0C = 800^0C$.

Therefore D_2 = 0.4 (1+ 0.0000125 x 800),

=> D_2 = 0.4(1 + 0.01),

=> D_2 = 0.4 X 1.01 = 0.404M.

(Q10) A compound strip of brass and iron 10cm long at 20^0c, is held horizontally with the iron upper most. When heated from below, the temperature of the brass is 820^0C and that of the iron is 770^0C. Calculate the difference in length of the brass and the iron [Linear expansivity: brass = 1.9 x $10^{-6}k^{-1}$, iron = 1.2 x $10^{-5}k^{1}$].

N/B:

$L_2 = L_1 (1 + \propto \triangle \theta)$

=> $L_2 = L_1 \{1 + \propto (\theta_2 - \theta_1)\}$

Soln:

<u>For brass:</u>

L_1 = 10cm, $\theta_1 = 20^0C$,

$\theta_2 = 820^0C$, $\propto$ = 1.9 x $10^{-6}k^{-1}$.

Therefore L_2 = 10{1 + 1.9 x 10^{-6}(820 – 20^0)}

=> L_2 = 10{1 + 1.9 x 10^{-6} x 800},

=> L_2 = 10{1 + 1520 x 10^{-6}},

$=> L_2 = 10\{1 + 0.00152\}$

$=> L_2 = 10\{1.00152\} = 10cm$

<u>For iron:</u>

$L_1 = 10cm$, $\theta_1 = 20^0C$,

$\theta_2 = 770^0C$, $\propto = 1.2 \times 10^{-5}k^{-1}$.

Therefore $L_2 = 10\{1 + 1.2 \times 10^{-5} \times (770 - 20)\}$,

$=> L_2 = 10\{1 + 1.2 X 10^{-5} X 750\}$,

$=> L_2 = 10\{1 +900 \times 10^{-5})$,

$=> L_2 = 10\{1 +9 \times 10^{-3}\}$,

$=> L_2 = 10\{1 + 0.009\}$,

$=> L_2 = 10\{1.009\}$.

$=> L_2 = 10.09 = 10.1cm$.

Difference in length $= L_2 - L_1$

$= 10.1 - 10 = 0.1cm$.

(Q11) A certain bimetallic strip is made of brass and iron with linear expansivities $1.9 \times 10^{-5}k^{-1}$ and $1.2 \times 10^{-5}k^{-1}$ respectively. At a certain temperature, T^0C, the length of the brass is 50^0cm and that of the iron is 60cm. If the bimetallic strip is heated, at what temperature would the lengths of the two metals be equal? (Express your answer in terms of T).

Soln:

<u>For brass:</u>

Let the original length of brass $= L_{B1} = 50cm = 0.5m$.

Let L_{B2} = the final length of brass.

Let $\propto_B$ = the linear expansivity of brass.

=>The new length of brass = $L_{B2} = L_{B1} (1 + \propto_B \triangle T)$,

=> $L_{B2} = 0.5 (1 + 1.9 \times 10^{-5} \triangle T)$.

<u>For iron:</u>

Let the original length of iron = L_{I1} = 60cm = 0.6m.

Let L_{I2} = the final length of iron, and let $\propto_I$ = the linear expansivity of iron. Then the new length of iron = $L_{I1} = L_{I1} (1 + \propto_I \triangle T)$,

=> $L_{I2} = 0.6 (1 + 1.2 X 10^{-5} K^{-1} \triangle T)$.

But at the desired temperature, the length of the brass = the length of the iron.

=> $0.5 (1 + 1.9 \times 10^{-5} \times \triangle T) = 0.6 (1 + 1.2 \times 10^{-5} \times \triangle T)$

Divide through using 0.5 => $\frac{0.5}{0.5} (1 + 1.9 \times 10^{-5} \times \triangle T) = \frac{0.6}{0.5} (1 + 1.2 \times 10^{-5} \triangle T)$,

=> $(1 + 1.9 \times 10^{-5} \times \triangle T) = 1.2(1 + 1.2 \times 10^{-5} \times \triangle T)$,

=> $1 + 1.9 \times 10^{-5} \times \triangle T = 1.2 + 1.44 \times 10^{-5} \triangle T$,

=> $1.9 \times 10^{-5} \times \triangle T - 1.44 \times 10^{-5} \triangle T = 1.2 - 1$,

=> $(1.9 - 1.44) \triangle T \times 10^{-5} = 0.2$,

=> $0.46 \times 10^{-5} \times \triangle T = 0.2$,

=> $\triangle T = \frac{0.2}{0.46 \times 10^{-5}}$

$= \frac{0.2}{0.46} \times 10^{5} = 0.4 \times 10^{5}$

= The desired temperature = the initial temperature + the change in temperature = $T + \triangle T = (T + 0.4 \times 10^{5})^{0}C$.

Cubical or volume expansivity:

- This is the expansion in the volume of a material.
- If Y = the cubical expansivity, then $Y = \frac{V_2 - V_1}{V_1(\theta_2 - \theta_1)}$, where V_1 = the original volume of the sheet = $L_1 \times b_1 \times h_1$.

- In this case L_1 = the original length, b_1 = the original breadth and h_1 =- the original height.
- The final volume after a rise in temperature = $V_2 = L_2 \times b_2 \times h_2$, where L_2 = the final length, b_2 = the final breadth and h_2 = the final height.
- For cubical expansivity, $Y = 3\propto$, where Y = cubical or volume expansivity and $\propto$ = linear expansivity.

(Q12) A metal box in the form of a cube of side 12cm is heated from 20^0c to 100^0c. If its linear expansivity is $1.4 \times 10^{-5}k^{-1}$, determine its new volume.

Soln:

The new volume = $V_2 = V_1(1 + Y\triangle\theta)$.

Also, $\propto = 1.4 \times 10^{-5}k^{-1}$.

Since $Y = 3\propto \Rightarrow Y = 3(1.4 \times 10^{-5})$,

$\Rightarrow Y = 4.2 \times 10^{-5}k^{-1}$.

$\triangle\theta = 100 - 20 = 80^0C$.

L = length of cube = 12cm = 0.12m,

=> volume of cube = $L^3 = 0.12^3$

= $0.0073m^3$, => the initial volume = $V_1 = 0.0073m^3$.

New volume = $V_2 = V_1 (1 + Y\triangle\theta)$,

$\Rightarrow V_2 = 00073 (1 + 4.2 X 10^{-5} X 80)$,

$\Rightarrow V_2 = 00073 (1 + 336 X 10^{-5})$,

$\Rightarrow V_2 = 00073(1 + 0.00336)$,

$\Rightarrow V_2 = 00073 \times 1.00336$,

$\Rightarrow V_2 = 7.3 \times 10^{-3} m^3$.

(Q13) The length of a side of a metallic cube at 20^0C is 5.0cm. Given that the coefficient of linear expansivity of the metal is $4.0 \times 10^{-5}k^{-1}$, determine the volume of the cube at 120^0C.

Soln:

Original volume = the volume of the cube at $20^0C = 5^3 = 125cm^3$.

Coefficient of linear expansivity $\propto = 4.0 \times 10^{-5}k^{-1}$.

Coefficient of volume expansivity $= Y = 3\propto = 3 \times 4.0 \times 10^{-5}$

$= 12 \times 10^{-5}k^{-1}$.

But since coefficient of volume expansivity $= \frac{Increase\ in\ volume}{original\ volume \times temperature\ rise}$

$\Rightarrow 12 \times 10^{-5} = \frac{Increase\ in\ volume}{125\ x\ (120-20)}$,

$\Rightarrow 12 \times 10^{-5} = \frac{Increase\ in\ volume}{125\ x\ 100}$,

$\Rightarrow 12 \times 10^{-5} = \frac{Increase\ in\ volume}{125\ 00}$,

$\Rightarrow 12 \times 10^{-5} \times 125\ 00$ = increase in volume,

$\Rightarrow 12 \times 10^{-5} \times 1.25 \times 10^4$ = increase in volume,

$\Rightarrow 15 \times 10^{-1}$ = increase in volume,

$\Rightarrow 1.5$ = increase in volume.

$\Rightarrow$ The increase in volume $= 1.5cm^3$.

$\Rightarrow$ Volume of cube at 120^0c

= original volume + increase in volume $= 125 + 1.5 = 126.5cm^3$.

Questions:

(Q1) Determine the expansion of a 20m copper rod, when it is heated from 20^0C to 30^0C, if the linear expansivity of copper is $0.000012k^{-1}$.

Ans: 0.0024m or 2.4×10^{-3}m.

(Q2) The coefficient of linear expansion of a certain metal is $0.000026k^{-1}$.

(a) Calculate the superficial expansion of the metal.
Ans: $0.000052k^{-1}$ or $5.2 \times 10^{-5}k^{-1}$.

(b) Determine the cubical expansion of this metal.
Ans: $0.000078k^{-1}$ or $7.8 \times 10^{-5}k^{-1}$.

(Q3) An electric pole which is made of a certain type of metal has a initial length of 80m. It was heated from a certain temperature to a final temperature of 60^0C, and its length increased to 80.0099m. If the metal has a linear expansivity of 0.0000034, determine its original temperature.

Ans: 56.4^0C.

(Q4) A metal box which is in the form of a cuboid of length 60cm, breadth 40cm and height 20cm, was heated from 10^0C to 80^0C. If its linear expansivity is $1.6 \times 10^{-5}k^{-1}$, find its new volume.

Ans: $0.048m^3$ or $4.816 \times 10^{-2}m^{-3}$.

(Q5) A piece of metal plate has a surface area of $200mm^2$, and a linear expansivity of $2.3 \times 10^{-5}k^{-1}$. What will be its new area if there is a rise in temperature from 20^0C to 80^0c?

Ans: $200.003mm^2$.

(Q6) A welder was engaged by a company to construct a money safe for the company`s use. He is to use a material in the form of a metal whose coefficient of linear expansivity is $3.2 \times 10^{-5}k^{-1}$. The safe is to be in the form of a cube whose side is expected to be 6cm, when the temperature is 40^0C. Find the volume of the cube, when the temperature is 140^0C.

Ans: 218^0C.

(Q7) With the aid of a labeled diagram, explain how you will determine in the laboratory, the linear expansivity of a metal rod.

(Q8) A metal, whose linear expansivity is $4.0 \times 10^{-5} k^{-1}$, is to be used in the construction of a safe which is in the form of a cube, and of length 5cm when the temperature is 20^0C. Determine the volume of the safe when the temperature increases by 100^0C.

Ans: $127cm^3$.

(Q9) The linear expansivity of a wire is $1.89 \times 10^{-5} k^{-1}$. Mr. Addo took 1.002m of this when its temperature was 30^0C and increased its temperature to 105^0C.

Calculate the increase or the expansion, with reference to the length of the wire.

Ans: $1.42 \times 10^{-3}m$.

(Q10) During physics practicals, a student took 50.2cm of a brass rod whose temperature was 16.7^0C and placed it inside an electric oven whose internal temperature was $9.9.5^0C$. If the rod expanded by 0.8cm, calculate an approximate value for the coefficient of linear expansivity of the rod.

Ans: $1.9 \times 10^{-5}\,{}^0C$.

(Q11) A 50m long metallic rod whose linear expansivity is $2.0 \times 10^{-5} k^{-1}$, is to be used in the construction of a structure. Determine the expected increase in length of the rod, if the surrounding temperature changes from 20^0C to 70^0C.

Ans: 0.05m.