

Question #76015, Physics / Other

An iron rod is 1.58m long at 0 degree celcius. What must be the length of brass rod at 0 degree celcius if the rod difference between the lengths of the two rods is to remain the same at all temperature

Solution:

Let x represent the length of the brass rod.

The length of a rod at any temperature is determined as follows.

$$L_T = L(1 + \alpha \Delta T)$$

Iron rod:

$$L_T = 1.58(1 + 11.8 \times 10^{-6} \Delta T)$$

Brass rod:

$$L_T = x(1 + 19 \times 10^{-6} \Delta T)$$

The difference at temperature T is

$$\begin{aligned} d &= 1.58(1 + 11.8 \times 10^{-6} \Delta T) - x(1 + 19 \times 10^{-6} \Delta T) = \\ &= 1.58 + 18.6 \times 10^{-6} \Delta T - x - 19 \times 10^{-6} \Delta T x \end{aligned}$$

The expression is constant in case when all terms with ΔT cancel out.

$$18.6 \times 10^{-6} \Delta T - 19 \times 10^{-6} \Delta T x = 0;$$

$$x = \frac{18.6 \times 10^{-6} \Delta T}{19 \times 10^{-6} \Delta T} = 0.98 \text{ m}$$

Answer: 0.98 m.

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