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Survey under "Useful Links" on website.

Thermal Expansion - when you warm an obj, it expands

\[
\frac{\Delta L}{L_0} = \alpha \Delta T
\]

Fractional inc. in length

\[
\frac{\Delta V}{V_0} = \beta \Delta T
\]

\[
\beta = 3\alpha
\]

\[
V_0 = L_0^3
\]

\[
V_f = (L_0 + \Delta L)^3 \approx L_0^3 + 3L_0^2 \Delta L + \ldots
\]
The coefficient of linear expansion for a special alloy of steel is $1.0 \times 10^{-5} / K$. What is the coefficient of linear expansion in $1/(\text{deg. C})$?

A) More than $1.0 \times 10^{-5} / (\text{deg C})$
B) Less than $1.0 \times 10^{-5} / (\text{deg C})$
C) Equal to $1.0 \times 10^{-5} / (\text{deg C})$

You’re installing a window of width 1m. The sides seem to have about 0.1mm of “give” overall (this is the thickness of a human hair). How much could the glass be heated and still fit in this space? Take $\alpha_{\text{glass}} = 3 \times 10^{-6} / K$

A) More than 50 deg C.
B) Less than 50 deg C.

ANS: 5
The coefficient of linear expansion for a special alloy of steel is $1.0 \times 10^{-5} / \text{K}$. How much would you have to increase the temperature to increase the area of the plate by 1%?

A) 5 Kelvin
B) 10 Kelvin
C) 50 Kelvin
D) 100 Kelvin
E) None of the above

\[
\frac{\Delta A}{A} = 2 \times \Delta T = 0.01
\]

\[
(2.0 \times 10^{-5}) \frac{T}{2 \times 10^{-5}} = 1 \to 2
\]

\[
T = \frac{10^{-2}}{2 \times 10^{-5}} \text{ K} = 500 \text{ K}
\]

Brass has a positive coefficient of thermal expansion $\alpha$ ($\Delta L = \alpha L_0 \Delta T$). A ring (annulus) of brass is heated. Does the hole in the middle of the ring get larger or smaller?

A) larger
B) smaller
C) stays the same

Hint: Imagine you had a ring (basically linear, right?)
3 Phase Diagrams

Suppose I have ice @ -20°C

T_fusion

T_v = Vaporization

boiling

water

steam

heat added to ice.

(boils diff. @ diff. pressures)

0.0001 atm

ice @ T_v

steam

ice

sublimation

heat added

Phase Diagram for Water

\[ H_2O \]

Pressure P

Temperature

solid

liquid

gas
Which of the following is NOT true?

A) The material is a fluid at 1 atm & room temp.  True  
B) The material sublimes at atmospheric pressure  False  
C) The maximum density of the material is in its solid phase  True