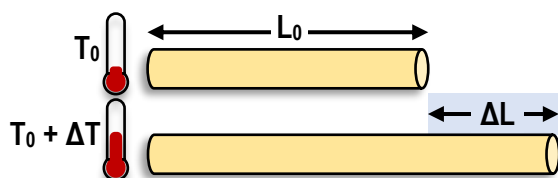


CONCEPT: VOLUME THERMAL EXPANSION

- When you increase the temperature of a **3D object** (e.g a sphere or cube) their _____ also increases.

LINEAR Thermal Expansion (1D)

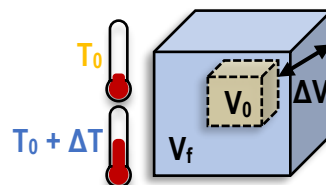


$$\Delta L = \alpha L_0 \Delta T$$

$$L_f = L_0(1 + \alpha \Delta T)$$

- α = linear expansion coefficient

VOLUMETRIC Thermal Expansion (3D)



$$\Delta V = \underline{\hspace{2cm}}$$

$$V_f = \underline{\hspace{2cm}}$$

- β = volume expansion coefficient

- For the same material, $\beta = \underline{\hspace{2cm}}$

	α	$\beta=3\alpha$
Aluminum	2.4×10^{-5}	7.2×10^{-5}
Copper	1.7×10^{-5}	5.1×10^{-5}
Steel	1.1×10^{-5}	3.3×10^{-5}

EXAMPLE: A ball of lead at a temperature 333K has a volume of 50.000cm³. By how much does the ball shrink when you decrease the temperature to 303K? The coefficient of linear expansion for lead is 2.9×10^{-5} .

PROBLEM: A geodesic, hemispherical dome made of aluminum has a diameter of exactly 50m on a winter day at a temperature of -10°C . How much more interior space does the dome have on a summer day at a temperature of 30°C ? The volume expansion coefficient for aluminum is 7.2×10^{-5} .

VOLUME THERMAL EXPANSION

$\Delta V = \beta V_0 \Delta T$

$V_f = V_0(1 + \beta \Delta T)$

PROBLEM: A 250cm^3 flask is completely filled with mercury (Hg) at 0°C . If you increase the temperature of the flask and mercury to 100°C , how much mercury (in cm^3) overflows and spills out of the flask?

VOLUME THERMAL EXPANSION

$\Delta V = \beta V_0 \Delta T$

$V_f = V_0(1 + \beta \Delta T)$

$\beta_{\text{Hg}} = 1.8 \times 10^{-4}$
--

$\beta_{\text{glass}} = 1.2 \times 10^{-5}$
