

CONCEPT: LINEAR THERMAL EXPANSION

- **Thermal Expansion:** If you increase the temperature of most materials, their _____ also increases (i.e. they expand).
 - For roughly 1D objects (like a rod), changing temperature (ΔT) also changes the _____ (ΔL) of the rod.

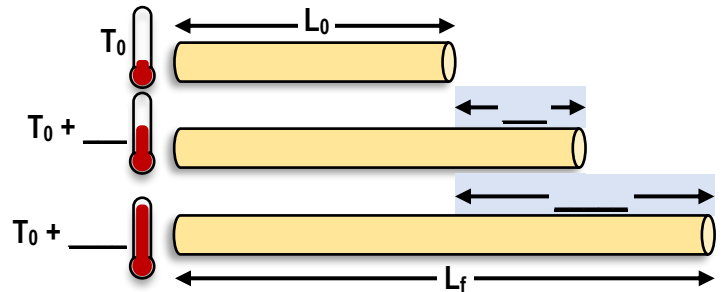
$$\Delta L = \underline{\hspace{2cm}}$$

α = coefficient of linear expansion [Units: $\frac{1}{K}$ or $\frac{1}{^{\circ}C}$]

L_0 = initial length of object

- Sometimes you'll have to calculate the final length L_f .
 - We can use $\Delta L = L_f - L_0$ to write an EQ for L_f :

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



EXAMPLE: An aluminum metal rod has an initial length of exactly 50.000m at an initial temperature of 20°C. If the coefficient of linear expansion for aluminum is 2.4×10^{-5} , **a)** by how much does the length of the rod increase if you heat it up to 35°C? **b)** What would the final length of the rod be if you continued heating it up to 50°C?

- ΔT is the **same** in K and $^{\circ}C$, so we can use either ΔT_K or ΔT_C in these equations.

PROBLEM: On a very cold day at a temperature of -12°C , a power line made of aluminum between two support towers measures exactly 150.56m. You go out on a hot day and measure the power line to be exactly 150.71m. What is the temperature (in $^{\circ}\text{C}$) outside? The linear expansion coefficient of aluminum is 2.4×10^{-5} .

- A) 29.5°C
- B) -11.8°C
- C) 41.7°C

LINEAR THERMAL EXPANSION

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

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

PROBLEM: Steel measuring tape is usually calibrated for measurement accuracy at 20°C . If the measuring tape is exactly 50m long at this temperature, what is the length of the tape at 40°C ? The linear expansion coefficient of steel is 1.2×10^{-5} .

LINEAR THERMAL EXPANSION

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

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