CONCEPT: LINEAR THERMAL EXPANSION

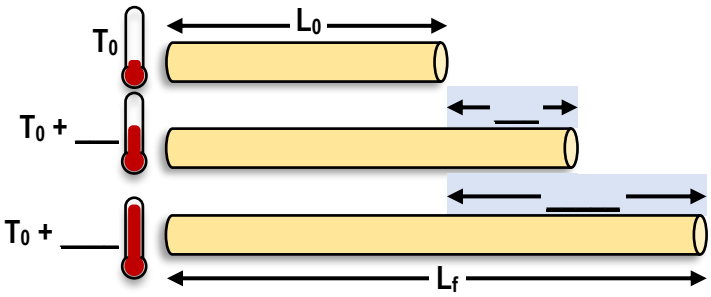
● **Thermal Expansion:** If you increase the temperature of most materials, their _____ also increases (i.e. they expand).

- For roughly 1D objects (like a rod), changing temperature (***ΔT***) also changes the _____ (***ΔL***) of the rod.

ΔL = _____

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 = _____

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