

1.45 Place the following temperatures in order from highest to lowest in units of K and °R: $T_A = 30^\circ\text{C}$, $T_B = 30^\circ\text{F}$, $T_C = 30^\circ\text{R}$, and $T_D = 30\text{ K}$.

KNOWN: Specified temperatures of $T_A = 30^\circ\text{C}$, $T_B = 30^\circ\text{F}$, $T_C = 30^\circ\text{R}$, and $T_D = 30\text{ K}$.

FIND: Order the temperatures from highest to lowest in units of K and °R.

SCHEMATIC AND GIVEN DATA:

Temperatures

$$T_A = 30^\circ\text{C}$$

$$T_B = 30^\circ\text{F}$$

$$T_C = 30^\circ\text{R}$$

$$T_D = 30\text{ K}$$

ANALYSIS:

Convert temperature A from °C to K using Eq. 1.17

$$T(^{\circ}\text{C}) = T(\text{K}) - 273.15 \quad \rightarrow \quad T(\text{K}) = T(^{\circ}\text{C}) + 273.15$$

$$T_A(\text{K}) = 30^\circ\text{C} + 273.15 = \mathbf{303.15\text{ K}}$$

Next apply Eq. 1.16 to solve for temperature A in °R

$$T(^{\circ}\text{R}) = 1.8T(\text{K})$$

$$T_A(^{\circ}\text{R}) = (1.8)(303.15\text{ K}) = \mathbf{545.67^{\circ}\text{R}}$$

Convert temperature B from °F to °R by rearranging Eq. 1.18

$$T(^{\circ}\text{F}) = T(^{\circ}\text{R}) - 459.67 \quad \rightarrow \quad T(^{\circ}\text{R}) = T(^{\circ}\text{F}) + 459.67$$

$$T_B(^{\circ}\text{R}) = 30^{\circ}\text{F} + 459.67 = \mathbf{489.67^{\circ}\text{R}}$$

Next rearrange Eq. 1.16 to solve for temperature B in K

$$T(^{\circ}\text{R}) = 1.8T(\text{K}) \quad \rightarrow \quad T(\text{K}) = T(^{\circ}\text{R})/1.8$$

$$T_B(\text{K}) = 489.67^{\circ}\text{R}/1.8 = \mathbf{272.04\text{ K}}$$

Using Eq. 1.16 to solve for temperature C in K

$$T_C(\text{K}) = 30^{\circ}\text{R}/1.8 = \mathbf{16.67\text{ K}}$$

Using Eq. 1.16 to solve for temperature D in °R

$$T_D(^{\circ}\text{R}) = (1.8)(30 \text{ K}) = \mathbf{54^{\circ}\text{R}}$$

Temperatures ordered from highest to lowest are:

	Temperature (K)	Temperature ($^{\circ}\text{R}$)
Highest Temperature	$T_A = 303.15 \text{ K}$	$T_A = 545.67^{\circ}\text{R}$
↓	$T_B = 272.04 \text{ K}$	$T_B = 489.67^{\circ}\text{R}$
↓	$T_D = 30 \text{ K}$	$T_D = 54^{\circ}\text{R}$
Lowest Temperature	$T_C = 16.67 \text{ K}$	$T_C = 30^{\circ}\text{R}$

In this case, the order of temperatures from highest to lowest is the same for K and $^{\circ}\text{R}$.