1.48 Air temperature rises from a morning low of 42°F to an afternoon high of 70°F.
(a) Express these temperatures in °R, K, and °C.
(b) Determine the temperature *change* in °F, °R, K, and °C from morning low to afternoon high.
(c) What conclusion do you draw about temperature *change* for °F and °R scales?
(d) What conclusion do you draw about temperature *change* for °C and K scales?

KNOWN: Morning low temperature and afternoon high temperature, both in °F.

FIND: (a) Express these temperatures in °R, K, and °C, (b) temperature *change* in °F, °R, K, and °C from morning low to afternoon high, (c) conclusion about temperature *change* for °F and °R scales, (d) conclusion about temperature *change* for °C and K scales.

SCHEMATIC AND GIVEN DATA:

$T_{low} = 42^{o}F$
$T_{high} = 70^{o}F$

ANALYSIS:
(a) First convert temperatures from °F to °R using Eq. 1.18 to solve for temperatures in °R

$$T(^{o}F) = T(^{o}R) - 459.67 \rightarrow T(^{o}R) = T(^{o}F) + 459.67$$

T_{low} (^{o}R) = 42 ^{o}F + 459.67 = **501.67°R**

T_{high} (^{o}R) = 70 ^{o}F + 459.67 = **529.67°R**

Next apply Eq. 1.16 to solve for temperature in K

$$T(^{o}R) = 1.8T(K) \rightarrow T(K) = T(^{o}R)/1.8$$

T_{low} (K) = 501.67°R/1.8 = **278.71 K**

T_{high} (K) = 529.67°R/1.8 = **294.26 K**

Finally, apply Eq. 1.17 to solve for temperature in °C

$$T(^{o}C) = T(K) - 273.15$$

T_{low} (^{o}C) = 278.71 K – 273.15 = **5.56°C**

T_{high} (^{o}C) = 294.26 K – 273.15 = **21.11°C**

(b) Temperature change, ΔT, is $T_{high} - T_{low}$. Calculating the differences yields

$\Delta T(^{o}F) = 70^{o}F - 42^{o}F =$ **28°F**

$\Delta T(^{o}R) = 529.67^{o}R - 501.67^{o}R =$ **$28^{o}R$**

$\Delta T(K) = 294.26\ K - 278.71\ K =$ **$15.55\ K$**

$\Delta T(^{o}C) = 21.11\ ^{o}C - 5.56\ ^{o}C =$ **$15.55^{o}C$**

(c) For ^{o}F and ^{o}R scales, the temperature *change* is the same since a Rankine degree and a Fahrenheit degree are the same temperature unit.

(d) For ^{o}C and K scales, the temperature *change* is the same since a Kelvin degree and a Celsius degree are the same temperature unit.