Temperature Units in MathCad

(Dr. Tom Co, 9/24/2008)

Introduction

There are two absolute temperature scales: Kelvin (K) and Rankine (R), where

$$1\,R = 1.8\,K \tag{1}$$

The relationship among $°C$, $°F$, R and K are given by

$$(T \text{ in } °C) = (T \text{ in } K) - 273.15 \tag{2}$$

$$(T \text{ in } °F) = (T \text{ in } R) - 460.67 \tag{3}$$

$$(T \text{ in } °C) = \frac{(T \text{ in } °F) - 32}{1.8} \tag{4}$$

During computations, there is another pair of units used to describe change in temperature ΔT:

$$1\Delta°C = 1K \tag{5}$$

$$1\Delta°F = 1R \tag{6}$$

MathCad Implementation

1. Both R and K are built-in units in MathCad. This means that they can easily be redefined within a MathCad worksheet. It is strongly advisable to avoid using R or K to define variables, e.g. use R_g to define the universal gas constant.
2. When defining a temperature in either $°C$ or $°F$, position the cursor next to the constant or variable, then press **[ctrl shift x]** to obtain a placeholder. Then [ctrl u] to get the insert units window. Finally select either $°C$ or $°F$. (For $\Delta°C$ or $\Delta°F$, you do not need to use **[ctrl shift x].**)
3. When using empirical formula involving temperature that were obtain in terms of $°C$ or $°F$, a non-dimensionalization may be required. To do so, we have

$$\frac{(T \text{ in } °C) - 0°C}{1\,K} \qquad \frac{(T \text{ in } °F) - 0°F}{1\,R} \tag{7}$$

Example:

$i := 0, 1 .. 3$ $\qquad kJ := 10^3 \cdot joule$

$a_i :=$

$36.11 \cdot 10^{-3}$
$4.233 \cdot 10^{-5}$
$-2.887 \cdot 10^{-8}$
$7.464 \cdot 10^{-12}$

$$C_p(T) := \left[\sum_{i=0}^{3} \left[a_i \cdot \left(\frac{T - 0\,℃}{1K} \right)^i \right] \right] \cdot \frac{kJ}{mol \cdot K}$$

+

$$\Delta H(n, T_{initial}, T_{final}) := n \cdot \int_{T_{initial}}^{T_{final}} C_p(T)\, dT$$

$\Delta H(100mol, 30\,℃, 90\,℃) = 231.235kJ$