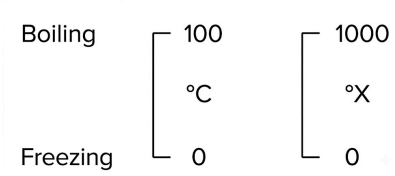
3. A new temperature scale is desired with freezing of water at 0°X and boiling point at atmospheric pressure occurring at 1000°X. Derive a conversion between degrees Celsius and degrees X. What is the absolute zero in degrees X?

From the problem and standard thermodynamic values provided in the module, we know the reference points for water at standard atmospheric pressure:



Because temperature scales are linear relationships, we can establish a conversion formula using the equation of a straight line, $y = mx + b$, or by setting up a ratio of corresponding temperature intervals:

$$\frac{T_X - 0}{1000 - 0} = \frac{T_C - 0}{100 - 0}$$

$$T_X = 10\,T_C$$

Now that we have derived the conversion equation $\left(T_X = 10\,T_C\right)$, we can find absolute zero in the new scale by substituting the Celsius value for absolute zero $\left(T_C = -\,273.15\ {}^{o}C\right)$:

$$T_X = 10\left(-\,273.15\ {}^{o}C\right)$$

$$T_X = -\,2731.5\ {}^{o}X$$

*The essence of this problem is understanding **scale proportionality**. The new scale (X) stretches the exact same physical interval between water freezing and boiling into 1000 units instead of Celsius's 100 units. This means **1°C is exactly equal to 10°X** in size. Because every step on the Celsius scale is amplified tenfold on the X scale, absolute zero—which sits 273.15 steps below freezing in Celsius—drops down by 2,731.5 steps on the X scale, reaching **-2,731.5°X**.*