

Exercise 1.78

Suppose you decide to define your own temperature scale with units of O, using the freezing point (13 °C) and boiling point (360 °C) of oleic acid, the main component of olive oil. If you set the freezing point of oleic acid as 0 °O and the boiling point as 100 °O, what is the freezing point of water on this new scale?

Solution

Any temperature scale is a linear function, which has the general form

$$(O^\circ) = m(C^\circ) + b.$$

Using the two data points given, we can determine the two unknowns, m and b . 100 °O corresponds with 360 °C, and 0 °O corresponds with 13 °C.

$$100 = m(360) + b$$

$$0 = m(13) + b$$

Solve this second equation for b

$$b = -13m \tag{1}$$

and plug it into the first equation.

$$100 = m(360) + (-13m)$$

$$100 = 347m$$

$$m = \frac{100}{347} \tag{2}$$

Substitute this result back into equation (1) to get b .

$$b = -13 \left(\frac{100}{347} \right) = -\frac{1300}{347}$$

Therefore, the new temperature scale is

$$(O^\circ) = \frac{100}{347}(C^\circ) - \frac{1300}{347},$$

and a temperature of 0 °C (the freezing point of water) corresponds with

$$(O^\circ) = \frac{100}{347}(0) - \frac{1300}{347} = -\frac{1300}{347} \approx -3.75 \text{ }^\circ\text{O}.$$