Exercise 1.33

Make the following conversions: (**a**) 72 °F to °C, (**b**) 216.7 °C to °F, (**c**) 233 °C to K, (**d**) 315 K to °F, (**e**) 2500 °F to K, (**f**) 0 K to °F.

Solution

Part (a)

Use the formula to convert from Fahrenheit to Celsius temperature scales.

$$\begin{aligned} ^\circ\text{C} &= \frac{5}{9}(^\circ\text{F} - 32) \\ &= \frac{5}{9}(72 - 32) \\ &\approx 22^\circ \end{aligned}$$

72 °F is about 22 °C.

Part (b)

Use the formula to convert from Celsius to Fahrenheit temperature scales.

$$\begin{aligned} ^\circ\text{F} &= \frac{9}{5}(^\circ\text{C}) + 32 \\ &= \frac{9}{5}(216.7) + 32 \\ &\approx 422.1^\circ \end{aligned}$$

216.7 °C is about 422.1 °F.

Part (c)

Use the formula to convert from Celsius to Kelvin temperature scales.

$$\begin{aligned} \text{K} &= ^\circ\text{C} + 273.15 \\ &= 233 + 273.15 \\ &\approx 506 \end{aligned}$$

233 °C is about 506 K.

Part (d)

Solve the formula in part (c) for °C

$$\text{K} - 273.15 = \text{°C}$$

and combine it with the formula in part (a).

$$\text{K} - 273.15 = \frac{5}{9}(\text{°F} - 32) \tag{1}$$

Solve for °F.

$$\frac{9}{5}(\text{K} - 273.15) = \text{°F} - 32$$

$$\frac{9}{5}(\text{K} - 273.15) + 32 = \text{°F}$$

As a result,

$$\begin{aligned} \text{°F} &= \frac{9}{5}(315 - 273.15) + 32 \\ &\approx 107^\circ. \end{aligned} \tag{2}$$

315 K is about 107 °F.

Part (e)

Solve equation (1) for K.

$$\begin{aligned} \text{K} &= 273.15 + \frac{5}{9}(\text{°F} - 32) \\ &= 273.15 + \frac{5}{9}(2500 - 32) \\ &\approx 1600 \end{aligned}$$

2500 °F is about 1600 K.

Part (f)

Use equation (2) to determine the Fahrenheit temperature of 0 K.

$$\begin{aligned} \text{°F} &= \frac{9}{5}(\text{K} - 273.15) + 32 \\ &= \frac{9}{5}(0 - 273.15) + 32 \\ &= -459.67^\circ \end{aligned}$$

0 K is −459.67 °F.