Important Formulas

- **Celsius To Fahrenheit Scale**

$$T_F = \frac{9}{5} T_c + 32$$
$$T_F = 1.8\, T_c + 32$$

- **Celsius to Kelvin Scale**

$$T_K = 273 + T_C$$

7.1. Normal human body temperature is $98.6°F$. Convert it into Celsius scale and Kelvin scale.

Given Data

$$Temperature\ in\ Fahrenheit = T_F = 98.6°\text{F}$$

To Find

$$Temperature\ in\ Celsius = T_C = ?$$
$$Temperature\ in\ Kelvin = T_K = ?$$

Solution

By using Fahrenheit scale

$$T_F = \frac{9}{5} T_c + 32$$
$$T_F = 1.8\, T_c + 32$$
$$98.6 = 1.8\, T_c + 32$$
$$98.6 - 32 = 1.8\, T_c$$
$$66.6 = 1.8\, T_c$$
$$\frac{66.6}{1.8} = T_c$$
$$37 = T_c$$
$$\boldsymbol{T_c = 37°\text{C}}$$

Now by using Kelvin scale

$$\boldsymbol{T_K = 273 + T_C}$$
$$\boldsymbol{T_K = 273 + 37}$$
$$\boldsymbol{T_K = 310\ K}$$

7.2. At what temperature Celsius and Fahrenheit thermometer reading would be the same?

Given Data

$$Let\ temperature\ in\ Celsius = T_C = T$$
$$And\ temperature\ in\ Fahrenheit = T_F = T$$

To Find

$$Temperature\ at\ which = T = T_C = T_F$$

Solution

By using Fahrenheit scale

$$T_F = \frac{9}{5} T_c + 32$$
$$T = \frac{9}{5} T + 32 \qquad \because T = T_C = T_F$$
$$T = 1.8\, T + 32$$
$$T - 1.8T = 32$$
$$-0.8T = 32$$
$$T = \frac{32}{-0.8}$$
$$\boldsymbol{T = -40}$$

OR

$$T_F = \frac{9}{5} T_c + 32$$
$$T = \frac{9}{5} T + 32 \qquad \because T = T_C = T_F$$
$$T = \frac{9\, T + 160}{5}$$
$$5T = 9\, T + 160$$
$$5T - 9T = 160$$
$$-4T = 160$$
$$T = \frac{160}{-4}$$
$$\boldsymbol{T = -40}$$

7.3. Convert $5°\text{F}$ to Celsius and Kelvin scale.

Given Data

$$Temperature\ in\ Fahrenheit = T_F = 5°\text{F}$$

To Find

$$Temperature\ in\ Kelvin = T_K = ?$$

Solution

By using Fahrenheit scale

$$T_F = 1.8\, T_c + 32$$
$$5 = 1.8\, T_c + 32$$
$$5 - 32 = 1.8\, T_c$$
$$-27 = 1.8\, T_c$$
$$\frac{-27}{1.8} = T_c$$
$$-15 = T_c$$
$$T_c = -15°\text{C}$$

Now by using Kelvin scale

$$T_K = 273 + T_C$$
$$T_K = 273 + (-15)$$
$$T_K = 273 - 15$$
$$\boldsymbol{T_K = 258\ K}$$

7.4. What is equivalent temperature of 25°C on Fahrenheit and Kelvin scales?

Given Data

$$Temperature\ in\ Celsius = T_C = 25°\text{C}$$

To Find

$$Temperature\ in\ Fahrenheit = T_F = ?$$
$$Temperature\ in\ Kelvin = T_K = ?$$

Solution

By using formula of Fahrenheit scale

$$T_F = 1.8\, T_c + 32$$
$$T_F = 1.8\,(25) + 32$$
$$T_F = 45 + 32$$
$$\boldsymbol{T_F = 77\ °\text{F}}$$

Now by using Kelvin scale

$$T_K = 273 + T_C$$
$$T_K = 273 + 25$$
$$\boldsymbol{T_K = 298\ K}$$

7.5. The ice and steam points on an ungraduated thermometer are found to be $192\ mm$ apart. What temperature will be on Celsius scale if the length of mercury thread is at $67.2\ mm$ above the ice point mark?

Given Data

$$Length\ between\ ice\ and\ steam\ points = l_{100} = 192\ mm$$
$$Length\ of\ mercury\ thread = l_\theta = 67.2\ mm$$

To Find

$$Temperature\ on\ Celsius\ scale = T_C = ?$$

Solution

We use the formula for temperature on a linear scale:

$$T_C = \frac{l_\theta}{l_{100}} \times 100$$

$$T_C = \frac{67.2}{192} \times 100$$
$$\boldsymbol{T_C = 35°C}$$

7.6. The length between the fixed point of liquid-in-glass thermometer is $20\ cm$. If the mercury level is $4.5\ cm$ above the lower mark, what is the temperature on the Fahrenheit scale?

Given Data

$$Length\ between\ fixed\ points\ = l_{100} = 20\ cm$$
$$Length\ of\ mercury\ thread\ = l_\theta = 4.5\ cm$$

To Find

$$Temperature\ on\ Fahrenheit\ scale = T_F = ?$$

Solution

We use the formula for temperature on a linear scale:

$$T_C = \frac{l_\theta}{l_{100}} \times 100$$
$$T_C = \frac{4.5}{20} \times 100$$
$$T_C = 22.5°C$$

By using Fahrenheit scale

$$T_F = 1.8\,T_c + 32$$
$$T_F = (1.8\,)(22.5) + 32$$
$$T_F = 40.5 + 32$$
$$\boldsymbol{T_F = 72.5°F}$$