

TEMPERATURE

1. Temperature measured in degrees Celsius and degrees Fahrenheit have a linear dependence, therefore, it is:

$$F = kC + n$$

$$32 = 0k + n$$

$$n = 32$$

$$F = kC + n$$

$$212 = 100k + n$$

$$100k = 180$$

$$k = 1.8 = \frac{9}{5}$$

✓ $F = \frac{9}{5}C + 32$

2. Is there a temperature at which Celsius and Fahrenheit readings are the same?

$$F = C$$

$$\frac{9}{5}C + 32 = C$$

$$\frac{4}{5}C = -32$$

$$\underline{C = -40}$$

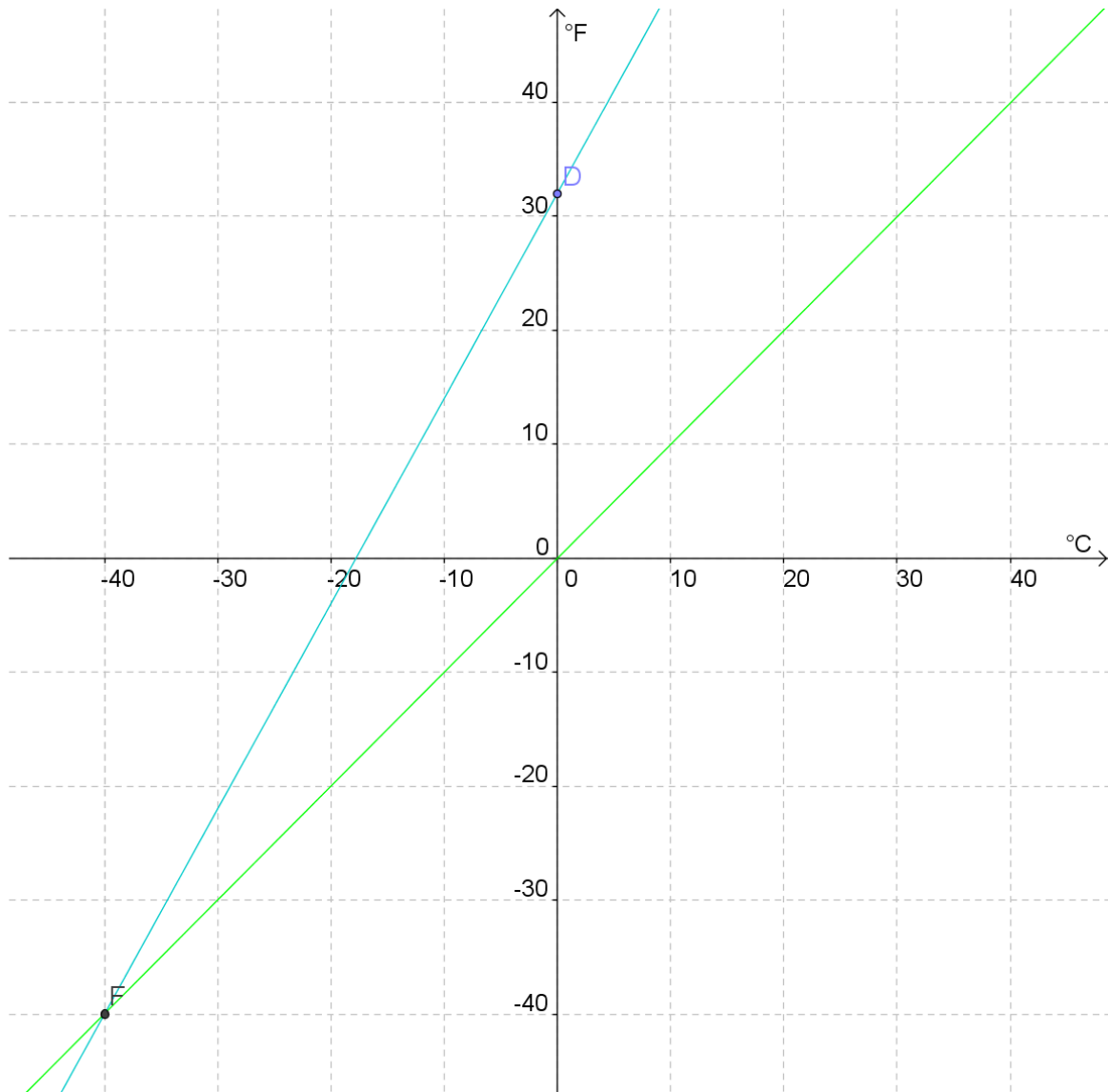
$$F = \frac{5}{9}F - \frac{160}{9}$$

$$9F = 5F - 160$$

$$4F = -160$$

$$\underline{F = -40}$$

- ✓ **Yes, the readings for degree Celsius and degree Fahrenheit are the same at -40 degrees.**
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- Can you describe a way of converting Fahrenheit readings into Celsius?

✓ $F = \frac{9}{5}C + 32$ ← with this equation we can convert °C to °F.

- Can you describe a way of converting Celsius readings into Fahrenheit?

✓ $C = \frac{5}{9}F - \frac{160}{9}$ ← with this equation we can convert °F to °C.

3. Is there a temperature at which the Fahrenheit reading is 20 degrees higher than reading?

$$F = C + 20$$

$$C = \frac{5}{9}F - \frac{160}{9} \quad | \cdot 9$$

$$F = \frac{5}{9}F - \frac{160}{9} + 20 \quad | \cdot 9$$

$$9C = 5F - 160$$

$$9F = 5F - 160 + 180$$

$$9C = 5 \cdot 5 - 160$$

$$4F = 20$$

$$9C = 25 - 160$$

$$F = 5^\circ$$

$$9C = -135$$

$$C = -15^\circ$$

- ✓ We found, that there exist two temperatures, where the Fahrenheit readings is 20 degrees higher than the Celsius readings, namely at 5°F and -15°C .
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4. Is there a temperature at which the Celsius reading is 20 degrees higher than the reading?

$$C = F + 20$$

$$C = \frac{9}{5}C + 32 + 20$$

$$F = \frac{9}{5}C + 32$$

$$-\frac{4}{5}C = 52 \quad | \cdot 5$$

$$F = \frac{9}{5} \cdot (-65) + 32$$

$$-4C = 260$$

$$F = -117 + 32$$

$$C = -65^\circ$$

$$F = -85^\circ$$

- ✓ We found, that there exist two temperatures, where the Celsius readings is 20 degrees higher than the Fahrenheit readings, namely at -85°F and -65°C .
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An extension challenge

Scientists often use the Kelvin scale of temperature, where the freezing point of water is 273.15°K and the boiling point of water is 373.15°K .

1. Is there a temperature at which Kelvin and Fahrenheit readings are the same?

$$F = Kk + n$$

$$32 = 273.15 \cdot k + n$$

$$n = 32 - 273.15k$$

$$n = 32 - 491.67$$

$$n = -459.67$$

$$F = Kk + (32 - 273.15k)$$

$$212 = 373.15k + 32 - 273.15k$$

$$212 = 100k + 32$$

$$k = 1.8 = \frac{9}{5}$$

$$\checkmark F = \frac{9}{5}K - 459.67$$

$$F = K$$

$$\frac{9}{5}K - 459.67 = K$$

$$\frac{4}{5}K = 495.67$$

$$K = 574.5875$$

$$K = kF + n$$

$$273.15 = 32k + n$$

$$n = 273.15 - 32k$$

$$n = 273 \frac{15}{100} - \frac{160}{9}$$

$$n = 273 \frac{135}{900} - 17 \frac{700}{900}$$

$$n = 255 \frac{335}{900}$$

$$K = kF + (273.15 - 32k)$$

$$373.15 = 212K + 273.15 - 32k$$

$$180k = 100$$

$$k = \frac{5}{9}$$

$$\checkmark K = \frac{5}{9}F + 255 \frac{335}{900}$$

$$K = F$$

$$\frac{5}{9}F + 255\frac{335}{900} = F$$

$$255\frac{335}{900} = \frac{4}{9}F$$

$$F = 574.5875$$

✓ **Yes, that temperature is 574.5875 °**

When converting Fahrenheit into Kelvin, we first take the general equation of one-way function $y = kx + n$, secondly we insert $F = kK + n$, next we take temperature for melting point and boiling point of water. Finally, we equalize equations.

2. Can you describe ways of converting Kelvin readings into Fahrenheit and Celsius readings?

Equation of one-way function for Kelvin is $K = \frac{5}{9}F + 255\frac{335}{900}$ and equation of one-way

function for Celsius is $C = \frac{5}{9}F - \frac{160}{9}$. Both functions K and C have the same slope $\frac{5}{9}$ and

we can see that lines are parallel and have no common point.