One Temperature, Three Scales

Convert sensor readings and compare temperature scales.

PHS.8.1 "Compare and contrast temperature scales by converting between Celsius, Fahrenheit, and Kelvin."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the two rules for converting from Celsius, circle each Celsius reading in the test log, and number the readings from coldest to warmest. Use your marks to check whether converted temperatures keep the same order.

Testing a Weather Station Sensor

1. Before a weather station goes outdoors, technicians test its temperature sensor in several conditions. The same sensor may report Celsius for local forecasts, Fahrenheit for a U.S. display, and Kelvin for a science data file. These scales describe the same thermal condition with different numbers, so the technicians must convert without changing the physical temperature.

2. Celsius and Kelvin have equal-sized steps, but their zero points differ. To convert Celsius to Kelvin, add 273.15. To convert Celsius to Fahrenheit, multiply by 9/5, then add 32. For a conversion back to Celsius, subtract 32 from Fahrenheit and multiply by 5/9. Kelvin temperatures are written without a degree sign.

3. The test log lists Celsius readings from four places around the station workshop. A colder reading should remain colder after conversion, even though its number changes. A difference of one Celsius degree is a difference of one kelvin, while a Celsius interval becomes 9/5 as large in Fahrenheit degrees. Use these relationships to check your calculations.

SENSOR TEST LOG

Test location	Temperature (°C)
Freezer chamber	-10
Room air	15
Sensor housing	35
Heated test chamber	60

2 ANSWER WITH EVIDENCE

Use the passage

1. Convert the freezer chamber reading to Fahrenheit and Kelvin. Why do the three numbers describe the same temperature?

2. Convert the room air reading to Fahrenheit. In Fahrenheit degrees, how much warmer is room air than the freezer chamber?

3. Convert the room air and sensor housing readings to Kelvin. Compare their difference in kelvins with their difference in Celsius degrees.

4. Convert the heated test chamber and sensor housing readings to Fahrenheit. Compare the difference in Fahrenheit degrees with the difference in Celsius degrees.

3 YOUR TURN

Your own words

Choose a Celsius temperature between -20°C and 80°C that is not in the test log. Convert it to Fahrenheit and Kelvin, then write two sentences showing your calculations and explaining why the three numbers differ.

ANSWER KEY

One Temperature, Three Scales

PART 1 · READ AND MARK

Underline the two rules for converting from Celsius, circle each Celsius reading in the test log, and number the readings from coldest to warmest. Use your marks to check whether converted temperatures keep the same order. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Convert the freezer chamber reading to Fahrenheit and Kelvin. Why do the three numbers describe the same temperature?	**-10°C = 14°F = 263.15 K. The scales assign different numbers to the same physical temperature.**
2	Convert the room air reading to Fahrenheit. In Fahrenheit degrees, how much warmer is room air than the freezer chamber?	**Room air is 59°F, and the freezer chamber is 14°F. Room air is 45 Fahrenheit degrees warmer.**
3	Convert the room air and sensor housing readings to Kelvin. Compare their difference in kelvins with their difference in Celsius degrees.	**Room air is 288.15 K, and the sensor housing is 308.15 K. Their difference is 20 K, equal in size to the 20°C difference.**
4	Convert the heated test chamber and sensor housing readings to Fahrenheit. Compare the difference in Fahrenheit degrees with the difference in Celsius degrees.	**The readings are 140°F and 95°F, a difference of 45 Fahrenheit degrees. The Celsius difference is 25 degrees, and 45 is 9/5 of 25.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

At 20°C, the temperature is (20 × 9/5) + 32 = 68°F and 20 + 273.15 = 293.15 K. The numbers differ because the scales have different zero points and Fahrenheit has a different step size, but all three describe the same temperature.

Accept equivalent calculations and rounding that does not change the comparison. Kelvin values should not use a degree sign.