

Heat

# Problem A

## TEMPERATURE CONVERSION

### PROBLEM

Summertime temperatures on Pluto's surface average 45 K—the only planet cold enough to keep methane solid. What is this temperature on the Celsius and Fahrenheit scales?

### SOLUTION

**Given:**  $T = 45 \text{ K}$

**Unknown:**  $T_C = ?$   $T_F = ?$

**Choose the equation(s) or situation:**

Use the Celsius-Kelvin equation and the Celsius-Fahrenheit equation

$$T_C = (T - 273)^\circ\text{C} = (45 - 273)^\circ\text{C} = \boxed{-228^\circ\text{C}}$$

$$T_F = \frac{9T_C}{5} + 32 = \frac{9}{5}(-228)^\circ\text{F} + 32^\circ\text{F} = (-4.10 + 10^2)^\circ\text{F} + 32^\circ\text{F}$$

$$T_F = \boxed{-378^\circ\text{F}}$$

### ADDITIONAL PRACTICE

1. When Mercury was farthest from the Sun in 1974 and 1975, the U.S. probe *Mariner 10* flew by Mercury three times to collect data. Surface temperatures ranged from 463 K during the day to 93 K at night. Express this temperature range in degrees Fahrenheit and in degrees Celsius.
2. On July 10, 1913, the temperature reached 330.0 K Death Valley, California—the hottest temperature ever reached in the United States. Calculate this temperature in degrees Fahrenheit and in degrees Celsius.
3. On January 21, 1918, Granville, North Dakota had a surprising change in temperature. Within 12 hours, the temperature changed from 237 K to 283 K. What is this change in temperature in the Celsius and Fahrenheit scales?
4. In only 15 minutes, the temperature in Fort Assiniboine, Montana, went from  $-5^\circ\text{F}$  to  $+37^\circ\text{F}$  on January 19, 1892. Calculate this change in temperature in kelvins.
5. *Hypothermia* is a condition in which the body gives up too much energy by heat to its colder surroundings. If a person's body temperature drops to  $90.0^\circ\text{F}$ , they can lose consciousness, and if their temperature falls to  $78^\circ\text{F}$ , they can die. What is this second temperature in kelvins?

6. Just as the human body cannot survive if its temperature falls to too low a temperature, it also cannot survive if its temperature is too high. In a condition called *hyperthermia*, energy is transferred to the body from its surroundings, causing the body's temperature to increase. The condition known as *heat stroke* is a severe form of hyperthermia. Normally, the human body cannot survive for long at a temperature of about  $42^{\circ}\text{C}$ , although a recent survivor of heat stroke had a high temperature of nearly  $47^{\circ}\text{C}$ . Express both of these temperatures in kelvins.
7. Air that slowly falls from high altitudes can result in cold fronts that sweep across many states. At 30,000 feet above Earth's surface, the air temperature can be around  $-67^{\circ}\text{F}$ . Find this temperature in kelvins.
8. The Hawaiian lavas at Kilauea Crater have the highest temperatures measured on Earth's surface—over  $2192^{\circ}\text{F}$ ! Express this temperature in degrees Celsius.
9. Much of the hot water in Reykjavík, Iceland comes from wells bored into the hot springs of Reykir. The water temperature from the wells is  $188.6^{\circ}\text{F}$ . Express this temperature in degrees Celsius.
10. The present temperature of the background radiation in the universe is 2.7 K. What is this temperature in degrees Celsius?