Name: _____ Date: _____

CONTENT 10.4

10.4 Pressure-Temperature Relationship

READ

The pressure-temperature relationship shows a direct relationship between the pressure of a gas and its temperature when the temperature is given in the **Kelvin** scale. Another name for this relationship is the Gay-Lussac Law. The pressure-temperature equation is shown at right.

PRESSURE-TEMPERATURE RELATIONSHIP

Initial pressure (atm) → $\frac{P_1}{T_1} = \frac{P_2}{T_2}$ ← *New pressure*

Initial temperature (K) → ← *New temperature*

Volume and mass constant

Converting from degrees Celsius to Kelvin is easy—you *add* 273 to the Celsius temperature. To convert from Kelvins to degrees Celsius, you *subtract* 273 from the Kelvin temperature.

EXAMPLE

A constant volume of gas is heated from 25.0°C to 100°C. If the gas pressure starts at 1.00 atmosphere, what is the final pressure of this gas?

Looking for

The new pressure of the gas (P_2)

Given

T_1 = 25 °C; P_1 = 1 atm; T_2 = 100 °C

Relationships

Use pressure-temperature relation to solve for P_2. Multiply each side by T_2 to isolate P_2 on one side of the equation.

$$P_2 = \frac{P_1 T_2}{T_1}$$

Convert temperature values in Celsius degrees to Kelvin: $T_{Kelvin} = T_{Celsius} + 273$

Solution

T_1 = 25 °C + 273 = 298

T_2 = 100 °C + 373 = 313

$$P_2 = \frac{1 \text{ atm} \times 373}{298} = 1.25 \text{ atm}$$

The new pressure of the volume of gas is 1.25 atmospheres.

PRACTICE

1. At 400. K, a volume of gas has a pressure of 0.40 atmospheres. What is the pressure of this gas at 273 K?

2. What is the temperature of the volume of gas (starting at 400. K with a pressure of 0.4 atmospheres), when the pressure increases to 1 atmosphere?

3. Use the pressure-temperature relationship to fill in the following table with the correct values. Pay attention to the temperature units.

	P_1	T_1	P_2	T_2
a.	30.0 atm	–100 °C		500 °C
b.	15.0 atm	25.0 °C	18.0 atm	
c.	5.00 atm		3.00 atm	293 K