Answer on Question #68149 Physics / Other

Gas Z in a cylinder at STP has a mass of 100 g. When the gas is compressed at 50 atm, the temperature of the gas increase to 850*celsius. Calculate the initial and final volume of the gas. (Mass of 1 mole of gas Z is 30 g, at STP: V =22.4 x 10 ^-3 m^3 , T= 0*Celsius , P = 1 atm).

Solution:

From the equation of state for perfect gas

$$PV = \frac{m}{\mu}RT$$

follows equation

$$V = \frac{m}{\mu}\frac{RT}{P}.$$

Using relations for SI units

$$1 \text{ atm} = 10^5 \text{ Pa}, \qquad T \text{ (K)} = t(^\circ\text{C}) + 273$$

we obtain for initial volume

$$V_1 = \frac{m}{\mu}\frac{RT_1}{P_1} = \frac{100}{30} \times \frac{8.31 \times 273}{10^5} = 0.076 \text{ m}^3,$$

and for final volume

$$V_2 = \frac{m}{\mu}\frac{RT_2}{P_2} = \frac{100}{30} \times \frac{8.31 \times 1123}{50 \times 10^5} = 0.006 \text{ m}^3.$$

Answer: $V_1 = 0.076 \text{ m}^3$, $V_2 = 0.006 \text{ m}^3$.