Answer on Question #75859, Chemistry / General Chemistry

A) A helium-filled balloon has a volume of 2.87 L at 15◦C. The volume of the balloon decreases to 2.46 L after it is placed outside on a cold day. What is the outside temperature in K? Answer in units of K.
003 (part 2 of 2) 10.0 points What is the outside temperature in ◦C? Answer in units of ◦C.
B) 004 10.0 points A lungful of air (387 cm3) is exhaled into a machine that measures lung capacity. If the air is exhaled from the lungs at a pressure of 2.17 atm at 42.7◦C but the machine is at ambient conditions of 0.958 atm and 23◦C, what is the volume of air measured by the machine? Answer in units of cm3.
C)005 10.0 points A balloon filled with helium gas has a volume of 341 mL at a pressure of 1atm. The balloon is released and reaches an altitude of 6.5km, where the pressure is 0.5atm. Assuming that the temperature has remained the same, what volume does the gas occupy at this height? Answer in units of mL.
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Solution

A) $V_1 = 2.87\ L = 2.87\ dm^3 = 2.87 \cdot 10^{-3} m^3$

$T_1 = 15^0C = 15+273.15\ K = 288.15\ K$

$V_2 = 2.46\ L = 2.46\ dm^3 = 2.46 \cdot 10^{-3}\ m^3$

T_2 -?

To find T_2 we should use Charles's Law:

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad \Rightarrow T_2 = T_1 \cdot V_2 / V_1;$$

$T_2 = 288.15\ K \cdot 2.46 \cdot 10^{-3}\ m^3 / 2.87 \cdot 10^{-3} m^3 = 246.99\ K$

Outside temperature in ^0C is $T_2 = 246.99-273.15 = 26.16\ ^0C$

B) $V_1 = 387\ cm^3 = 387 \cdot 10^{-6}\ m^3$

$P_1 = 2.17\ atm = 2.17 \cdot 101325\ Pa = 219875.25\ Pa$

$T_1 = 42.7^0C = 42.7 +273.15\ K = 315.85\ K$

$P_2 = 0.958\ atm = 0.958 \cdot 101325 Pa = 97069.35\ Pa$

$T_2 = 23^0C = 23+273.15\ K = 296.15\ K$

V_2 -?

To find volume V_2 we should use Combined gas Law:

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{219875.25\ \text{Pa}\cdot 387\cdot 10^{-6}\ \text{m}^3}{315.85\ \text{K}} = \frac{97069.35\ \text{Pa}\cdot V_2}{296.15\ \text{K}};$$

$V_2 = 822\cdot 10^{-6}\text{m}^3 = 822\ \text{cm}^3$

C) $V_1 = 341\ \text{mL} = 341\ \text{cm}^3 = 341\cdot 10^{-6}\ \text{m}^3$

$P_1 = 1\ \text{atm} = 101325\ \text{Pa}$

$P_2 = 0.5\ \text{atm} = 0.5\cdot 101325\ \text{Pa} = 50662.5\ \text{Pa}$

V_2 -?

To find V_2 we should use Boyle's Law:

$P_1V_1 = P_2V_2$;

$101325\ \text{Pa}\cdot 341\cdot 10^{-6}\ \text{m}^3 = 50662.5\ \text{Pa}\cdot V_2$;

$V_2 = 682\cdot 10^{-6}\ \text{m}^3 = 682\ \text{cm}^3 = 682\ \text{mL}$.

Answer: A) 246.99 K, 26.16 ^{0}C

B) 822 cm^3

C) 682 mL.