AP CHEMISTRY

TOPIC 3: GASES, PART A, EXAMPLE PROBLEMS

Day 34:

- Boyle, Charles, and Avogadro: Gas Laws
- Ideal Gas Law

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1) During Hurricane Katrina, the atmospheric pressure (barometric pressure) within the eye dropped to 27.33 inches of mercury. Express this pressure in each of the following units:

a) mm Hg b) atm c) kPa d) torr

$$\frac{27.33\ in\ Hg}{} \times \frac{2.54\ cm\ Hg}{1\ in\ Hg} \times \frac{10\ mm\ Hg}{1\ cm\ Hg} = 694\ mm\ Hg$$

$$\frac{27.33\ in\ Hg}{} \times \frac{2.54\ cm\ Hg}{1\ in\ Hg} \times \frac{10\ mm\ Hg}{1\ cm\ Hg} \times \frac{1\ atm}{760\ mm\ Hg} = 0.913\ atm$$

$$\frac{27.33\ in\ Hg}{} \times \frac{2.54\ cm\ Hg}{1\ in\ Hg} \times \frac{10\ mm\ Hg}{1\ cm\ Hg} \times \frac{1\ kPa}{7.501\ mm\ Hg} = 92.5\ kPa$$

$$\frac{27.33\ in\ Hg}{} \times \frac{2.54\ cm\ Hg}{1\ in\ Hg} \times \frac{10\ mm\ Hg}{1\ cm\ Hg} \times \frac{1\ torr}{1\ mm\ Hg} = 694\ torr$$

2) The volume of a balloon is 485 mL when filled with 0.0222 moles of helium gas fills at temperature of 20.0 ^{0}C. What is the pressure that the helium atoms are exerting on the sides of this balloon?

$$PV = nRT$$

$$\frac{485\ mL}{} \times \frac{1\ L}{1000\ mL} = 0.485\ L\ ;\ 20.0^{0}\text{C} + 273 = 293\ \text{K}\ ;$$

$$R = 0.0821\ \frac{atm \cdot L}{mol \cdot K}$$

$$P = \frac{nRT}{V} = \frac{(0.0222\ mol)(0.0821\ atm \cdot L)(293\ K)}{(0.485\ L)(mol \cdot K)} = 1.10\ atm$$

3) When 5.27 moles of nitrogen gas at 745 mm Hg of pressure at a volume of 2.00 L is compressed to a new pressure of 300. kPa – what will be the new volume for the nitrogen?

P_1 = 745 mm Hg
V_1 = 2.00 L
n_1 = 5.27 mol
T_1 = T_2

P_2 = 300 kPa
V_2 = **?**
n_2 = n_1
T_2 = T_1

$P_1V_1 = nRT$

$P_2V_2 = nRT$

$P_1V_1 = nRT = P_2V_2$

$$P_1V_1 = P_2V_2$$

$$V_2 = \frac{P_1V_1}{P_2} = \frac{(99.32\ kPa)(2.00\ L)}{300\ kPa} = 0.662\ L$$

$$\frac{745\ mm\ Hg}{} \times \frac{1\ kPa}{7.501\ mm\ Hg} = 99.32\ kPa$$

4) Determine the temperature of the gas if a sample of oxygen gas with an original volume of 4.55 liters and at a temperature of -45 ^{0}C has its volume reduced to 2.00 liters.

P_1 = P_2
V_1 = 4.55 L
n_1 = n_2
T_1 = -45 ^{0}C

P_2 = P_1
V_2 = 2.00 L
n_2 = n_1
T_2 = **?**

$PV_1 = nRT_1$

$PV_2 = nRT_2$

$-45^0C + 273 = 228\ K$

$$PV_1 = nRT_1\ ;\ P = \frac{nRT_1}{V_1}\ ;\ \frac{P}{nR} = \frac{T_1}{V_1}\ ;\ \frac{T_1}{V_1} = \frac{T_2}{V_2}$$

$$\frac{T_1}{V_1} = \frac{T_2}{V_2}$$

$$T_2 = \frac{T_1V_2}{V_1} = \frac{(228\ K)(2.00\ L)}{4.55\ L} = 100.\ K$$