4/9/20

5. The volume of 50.0 milliliters of an ideal gas at STP increases to 100. mL at a constant pressure. What will the new temperature be?

$V_1 = 50.0\text{ mL}$
$V_2 = 100.\text{ mL}$
$T_1 = 273\text{ K}$
$T_2 = ?$

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\quad \frac{50.0}{273} = \frac{100.}{T_2}$ $\quad \frac{50.0 \times T_2}{50.0} = \frac{27300}{50.0}$

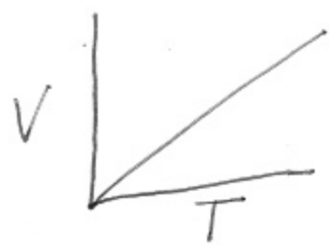
$T_2 = 546\text{ K}$

6. Equal volumes of all gases at the same temperature and pressure contain an equal number of

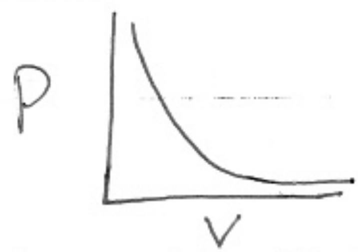
a) electrons b) protons c) molecules d) atoms

7. What gas law supports your answer from question #6?
Charles' Law

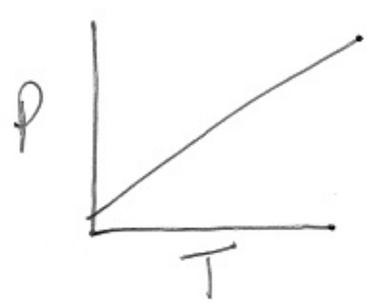
8. Draw a graph to illustrate the relationship between the volume of a gas (V) and its temperature (T) when pressure remains constant.



9. Draw a graph that represents the relationship between volume and pressure for an ideal gas at constant temperature.



10. Draw a graph that represents the relationship between temperature and pressure for an ideal gas at constant volume.



Gas Law Problems:

1. A gas fills a volume of 458 mL at a pressure of 1.01 kPa and a temperature of 295 K. When the pressure is changed, the volume becomes 577 mL. If there is no change in temperature, what is the new pressure?

$V_1 = 458 mL$
$P_1 = 1.01 KPa$
$T_1 = 295K$
$P_2 = ?$
$V_2 = 577 mL$

$P_1V_1 = P_2V_2$

$1.01 \times 458 = P_2 \times 577$

$\frac{462.6}{577} = \frac{P_2 \times 577}{577}$

$\boxed{P_2 = 0.8 KPa}$

2. A 10.0 L sample of argon gas is stored in a cylinder at room temperature of 23.8 °C and a pressure of 78.6 psi. The sample is completely transferred to another 2.80 L cylinder. Several hours after the transfer, the second cylinder has also attained room temperature. What is the pressure in the second cylinder?

$V_1 = 10.0L$
$T_1 = 23.8 + 273 = 296.8K$
$P_1 = 78.6 psi$
$V_2 = 2.80L$
$T_2 = 273K$
$P_2 = ?$

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

$\frac{78.6 \times 10.0}{296.8} = \frac{P_2 \times 2.80}{273}$

$\frac{214578}{831.04} = \frac{P_2 \times 831.04}{831.04}$

$\boxed{258.2 \text{ psi} = P_2}$

3. A tank of compressed CO_2 has a temperature of 20.0°C and a volume of 31.4 L. The CO_2 is completely transferred into a smaller tank with a volume of 25.0 L. Assuming none of the CO_2 escapes during the transfer, what does the temperature of the gas in the smaller tank need to be to have the pressure be the same as it was in the larger tank?

$T_1 = 20.0 + 273 = 293K$
$V_2 = 25.0L$
$V_1 = 31.4L$
$T_2 = ?$

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

$\frac{31.4}{293} = \frac{25.0}{T_2}$

$\frac{31.4 T_2}{31.4} = \frac{7325}{31.4}$

$\boxed{T_2 = 233K}$

4. A tank of compressed oxygen has a volume of 3.00 L and a pressure of 400. kPa at room temperature (21.0°C). The tank is accidentally thrown into a fire and the temperature increases to 200.°C. What is the pressure inside the tank?

$V_1 = 3.00L$
$P_1 = 400. KPa$
$T_1 = 21.0 + 273 = 294K$
$T_2 = 200 + 273 = 473K$
$P_2 = ?$

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

$\frac{400 KPa}{294 K} = \frac{P_2}{473K}$

$\frac{189200}{294} = \frac{294 \cdot P_2}{294}$

$\boxed{643.5 \text{ KPa} = P_2}$

5. At 75.0°C a gas has a volume of 2.20 L and exerts a pressure of 1.30 atm on the walls of the container. If the gas is compressed to a volume of 1.00 L and temperature is reduced to 10.0°C, what is the new pressure on the walls of the container?

$T_1 = 75.0 + 273 = 348K$
$V_1 = 2.20L$
$P_1 = 1.30atm$
$V_2 = 1.00L$
$T_2 = 10.0 + 273 = 283K$
$P_2 = ?$

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

$$\frac{1.30 \times 2.20}{348} = \frac{P_2 \times 1.00}{283}$$

$$\frac{809.4}{348} = \frac{348 \times P_2}{348}$$

$$\boxed{2.33\text{ atm} = P_2}$$

6. A gas at STP occupies a volume of 34.0 liters. What is the temperature of the gas if it is compressed to 20.0 liters by increasing the pressure to 250. kPa?

Table A

$V_1 = 34.0L$
$V_2 = 20.0L$
$P_1 = 101.3KPa$
$T_1 = 273K$
$P_2 = 250.0KPa$
$T_2 = ?$

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

$$\frac{101.3 \times 34.0}{273} = \frac{250.0 \times 20.0}{T_2}$$

$$\frac{3444.2 \times T_2}{3444.2} = \frac{1365000}{3444.2}$$

$$\boxed{T_2 = 396K}$$

7. You are given two equally sized containers of Ar and N_2 that both behave as ideal gasses and have equal pressures and temperatures.

a. Does each container have the same number of particles? Explain.

Yes, equal volumes of gases have the same number of particles.

b. Do they have the same number of atoms? Explain.

No, each molecule of N_2 contains 2 atoms

c. Do they have the same mass? Explain.

No, 1 mole of each substance has a different mass.

8. Using the first page of your Reference Tables, convert 2.6 atm to mmHg.

1 atm = 760 mmHg

$$\frac{1\text{ atm}}{760\text{ mmHg}} = \frac{2.6\text{ atm}}{X}$$

$X = 2.6 \times 760$
$X = 1976$ mmHg