

Name: _____

Period: _____

Seat#: _____

Directions: Solve the following problems (assume variables not mentioned are being held constant).
 Assume all number are 3 significant figures. Remember to show your work!

PART 1 – PRESSURE UNITS

1 atm = 760 mmHg = 760 torr = 101.3 kPa = 14.7 psi

Pressure is defined as Force / Area such as pounds per square inch (psi).

The weight of air pushing down per square inch is 14.7 pounds per square inch or 14.7 psi.

A barometer can be used to measure pressure. A column of mercury (Hg) that is 0.760 meter (760 mm) tall has the same weight as a column of air from sea level to the edge of the stratosphere. The height of this column is a good measure of air pressure... 760 mmHg.

Evangelista Torricelli did a lot of experiments with pressure and so 1 mmHg is also called 1 torr. So, air pressure has a value of 760 torr. This amount of pressure is also called 1 atm (one atmosphere) because it IS the atmosphere.

In metric units, pressure is Newtons (force) per square meter (area). One Newton is not very much pressure... about the weight of a small apple (get it... apple... Newton)... and if that force is exerted over a square meter, the amount of pressure is very small and called a pascal (Pa). It is more useful to talk of kilopascals (kPa) which would be the weight of 1000 small apples exerted over a square meter. Air pressure is equal to 101.3 kPa.

Since each of these values (see the top of the page) represent the same amount of pressure, any two of them can be used as a conversion factor. You can convert one pressure unit into another.

Example:

What is 515 mmHg in kPa?

$$\frac{515 \text{ mmHg}}{760 \text{ mmHg}} \times \frac{101.3 \text{ kPa}}{1} = 68.6440789 \text{ kPa} = 68.4 \text{ kPa}$$

Practice: You must use dimensional analysis and show your units canceling!

1) 745 mmHg into psi <u>14.4</u>	2) 522 torr into kPa <u>69.6</u>	3) 727 mmHg into kPa <u>96.9</u>
4) 1.10 atm into psi <u>16.2</u>	5) 52.5 kPa into atm <u>0.518</u>	6) 800. mmHg into atm <u>1.05</u>
7) 0.729 atm into mmHg <u>554</u>	8) 125 kPa into torr <u>938</u>	

PART 2 – BOYLE'S LAW

Boyle's Law states that the volume of a gas varies inversely with its pressure if temperature is held constant. (If one goes up, the other goes down.) We use the formula:

$$P_1 \times V_1 = P_2 \times V_2$$

- 1) A sample of oxygen gas occupies a volume of 250. mL at 740. torr pressure. What volume will it occupy at 800. torr pressure? 231 mL
- 2) A sample of carbon dioxide occupies a volume of 3.50 Liters at 125 kPa pressure. What pressure would the gas exert if the volume was decreased to 2.00 liters? 219 kPa
- 3) A 2.00-Liter container of nitrogen had a pressure of 3.20 atm. What volume would be necessary to decrease the pressure to 1.00 atm? 6.40 L
- 4) Ammonia gas occupies a volume of 450.0 mL as a pressure of 720. mmHg. What volume will it occupy at standard pressure (760 mmHg)? 426 mL
- 5) A 175 mL sample of neon had its pressure changed from 75.0 kPa to 150.0 kPa. What is its new volume? 87.5 mL

PART 3 – CHARLES' LAW

Charles' Law states the volume of a gas varies directly with the Kelvin temperature, assuming the pressure is constant. We use the following formulas:

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}; \quad K = ^\circ\text{C} + 273$$

- 1) A sample of nitrogen occupies a volume of 250 mL at 25°C. What volume will it occupy at 95°C? 309 ml
- 2) Oxygen gas is at a temperature of 40°C when it occupies a volume of 2.30 Liters. To what temperature should it be raised to occupy a volume of 6.50 Liters? 885 K / 612°C
- 3) Hydrogen gas was cooled from 150°C to 50°C. Its new volume is 75.0 mL. What was its original volume? 98.2 mL
- 4) Chlorine gas occupies a volume of 25.0 mL at 300 K. What volume will it occupy at 600 K? 50.0 mL
- 5) A sample of neon gas at 50°C and a volume of 2.50 Liters is cooled to 25°C. What is the new volume? 2.31 L

PART 4 – COMBINED GAS LAW

In practical terms, it is often difficult to hold any of the variables constant. When there is a change in pressure, volume and temperature, the combined gas law is used. We use the following formulas:

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}; \quad K = ^\circ\text{C} + 273$$

	P₁	V₁	T₁	P₂	V₂	T₂
1)	1.50 atm	3.00 L	20.0°	2.50 atm		30.0°C
2)	720. torr	256. mL	25.0°C		250. mL	50.0°C
3)	600. mmHg	2.50 L	22.0°C	760. mmHg	1.80 L	°C
4)		750. mL	0.00°C	2.00 atm	500. mL	25.0°C
5)	95.0 kPa	4.00 L	°C	101. kPa	6.00 L	198.°C

Answers: 1.86, 799, -3.96, 1.22, 22.3