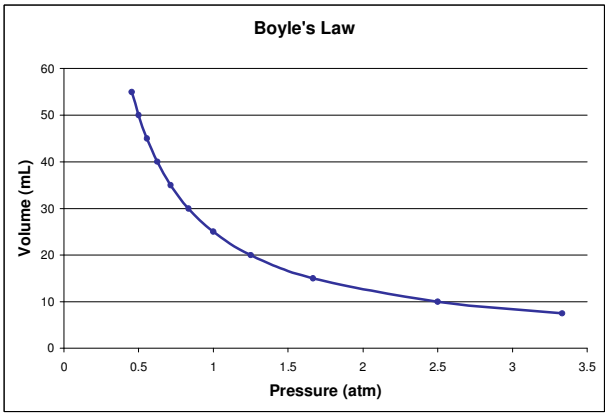
Boyle's Law
Worksheet

Name _____

Robert Boyle observed the relationship between the pressure and volume for a gas sample. These two variables are **inversely proportional**. This means that when the pressure goes up the volume goes down. This is expressed in the equation $P_1 \times V_1 = P_2 \times V_2$, which is known as **Boyle's Law**. The relationship between pressure and volume is only observed when the temperature and amount of gas particles do not change. The graph below shows this relationship.



USEFUL EQUATIONS

$P_1 \times V_1 = P_2 \times V_2$	1.00 atm = 760 mmHg
1.00 atm = 101300 Pa	1.00 atm = 760 torr
1.00 atm = 101.3 kPa	1.00 atm = 14.7 psi

example

A gas occupies a volume of 5.4 L at a pressure of 1.06 atm. What volume will the gas occupy if when the pressure is increased to 1.52 atm? Assume the temperature does not change.

- list the variables: $V_1 = 5.4$ L $P_1 = 1.06$ atm $P_2 = 1.52$ atm
- substitute into the equation: $P_1 \times V_1 = P_2 \times V_2$ $(1.06\ \text{atm}) \times (5.4\ \text{L}) = (1.52\ \text{atm}) \times V_2$
- solve: $\frac{(1.06\ \text{atm}) \times (5.4\ \text{L})}{1.52\ \text{atm}} = \frac{(1.52\ \text{atm}) \times V_2}{1.52\ \text{atm}}$ $V_2 = 3.8\ \text{L}$

Solve the following problems.

1. According to the graph, when the pressure of a gas sample is decreased what happens to the volume?
2. The gas in a 600 mL balloon has a pressure of 1.20 atm. If the temperature remains constant, what will be the pressure of the gas in the balloon when it is compressed to 400 mL?
3. An oxygen container has a volume of 48 mL and a pressure of 420 kPa. What is the volume of this gas when the pressure is 105 kPa?
4. A tank of compressed CO_2 has a pressure of 850 psi and a volume of 150 mL. What is the volume of this gas when the pressure is 45 psi?
5. A scuba tank has a pressure of 19,300 kPa and a volume of 10.3 L. What would be the pressure of the gas if it were transferred to a 50.0 L container?
6. Air fills a room with a volume of 5600 L. Atmospheric pressure is 740 torr. What will be the pressure if all of the gas is pumped into an 80 L tank? Convert this pressure to kPa.
7. A sample of 24 L of helium gas is stored in a cylinder at a pressure of 110 lb/in^2. The helium is transferred to a container with a volume of 15 L. Assuming the temperature has not changed what will be the pressure?
8. An air compressor has a volume of 110 L. What volume of gas is pumped into the tank if the pressure goes from 750 torr to a pressure of 145 psi?

1) It increases

2) $P_1V_1 = P_2V_2$

$1.2(600) = P_2(400)$

$\frac{720}{400} = \frac{P_2(400)}{400}$

$P_2 = 1.8$ atm

3) $P_1V_1 = P_2V_2$

$420(48) = 105(V_2)$

$\frac{20160}{105} = \frac{105(V_2)}{105}$

$V_2 = 192$ mL

4) $P_1V_1 = P_2V_2$

$850(150) = 45(V_2)$

$\frac{127500}{45} = \frac{45(V_2)}{45}$

$V_2 = 2833$ mL

5) $P_1V_1 = P_2V_2$

$19,300(10.3) = P_2(50)$

$\frac{198790}{50} = \frac{P_2(50)}{50}$

$P_2 = 3975.8$ kPa

6) $P_1V_1 = P_2V_2$

$760(5600) = P_2(80)$

$\frac{4256000}{80} = \frac{P_2(80)}{80}$

$P_2 = 53200$ torr $\times \frac{101.3 \text{ kPa}}{760 \text{ torr}} = 5389.160$ kPa

7) $P_1V_1 = P_2V_2$

$110(24) = P_2(15)$

$\frac{2640}{15} = \frac{P_2(15)}{15}$

$P_2 = 176$ lb/in^2

8) $P_1V_1 = P_2V_2$

* Must convert one of the pressures so units will cancel

$750 \text{ torr} \times \frac{14.7 \text{ psi}}{760 \text{ torr}} = 14.5$ psi

$14.5(110) = 145(V_2)$

$\frac{1595}{145} = \frac{145(V_2)}{145}$

$V_2 = 11$ L