# Boyle's Law Worksheet

Name **KEY**   Per____

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.

Boyle's Law graph — Volume (mL) vs Pressure (atm)
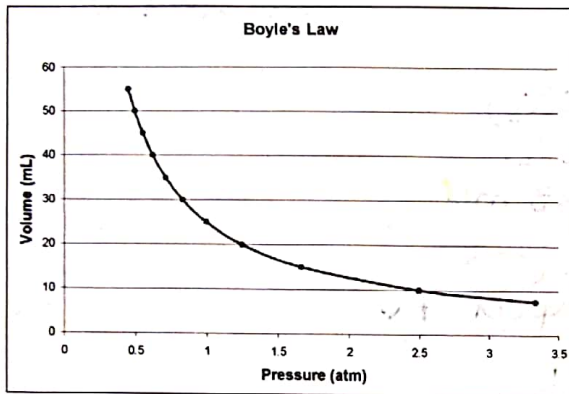
BOYLE'S LAW EQUATION
$$P_1 \times V_1 = P_2 \times V_2$$

PRESSURE UNITS/CONVERSIONS

1.00 atm = 760 mmHg   1.00 atm = 14.7 psi
1.00 atm = 101300 Pa   1.00 atm = 760 torr
1.00 atm = 101.3 kPa

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
$P_1 = 1.06\ atm$
$V_1 = 5.4\ L$
$P_2 = 1.52\ atm$
$V_2 = ?$

-substitute into the equation and solve
$P_1 \times V_1 = P_2 \times V_2$
$1.06\ (5.4) = 1.52\ (V_2)$
$5.724 = 1.52\ (V_2)$
$V_2 = 3.8\ L$

Solve the following problems.

1. According to the graph, when the pressure of a gas sample is decreased what happens to the volume?

   P+V have inverse relationship, so if pressure decreases, volume increases

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?   would expect P↑

   $P_1 = 1.20\ atm$ $P_1 V_1 = P_2 V_2$
   $V_1 = 600\ mL$ $1.2\ (600) = P_2\ (400)$
   $P_2 = ?$ $720 = P_2\ (400)$
   $V_2 = 400\ mL$ $P_2 = 1.8\ atm$

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?

would expect V↑

$P_1 = 420 \, kPa$

$V_1 = 48 \, mL$

$P_2 = 105 \, kPa$

$V_2 = ?$

$P_1 V_1 = P_2 V_2$

$420(48) = 105 (V_2)$

$20160 = 105 \, (V_2)$

$V_2 = 192 \, mL$

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?

would expect V↑

$P_1 = 850 \, psi$

$V_1 = 150 \, mL$

$P_2 = 45 \, psi$

$V_2 = ?$

$P_1 V_1 = P_2 V_2$

$850(150) = 45(V_2)$

$127,500 = 45(V_2)$

$V_2 = 2,833 \, mL$

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?

expect P↓

$P_1 = 19,300 \, kPa$

$V_1 = 10.3 \, L$

$P_2 = ?$

$V_2 = 50.0 \, L$

$P_1 V_1 = P_2 V_2$

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

$198790 = P_2 (50)$

$P_2 = 3975.8 \, kPa$

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?.

expect P↑

$P_1 = 740 \, torr$

$V_1 = 5600 \, L$

$P_2 = ?$

$V_2 = 80 \, L$

$P_1 V_1 = P_2 V_2$

$740 (5600) = P_2 (80)$

$4144000 = P_2(80)$

$P_2 = 51,800 \, torr$

7. A sample of 24 L of helium gas is stored in a cylinder at a pressure of 110 lb/in². The helium is transferred to a container with a volume of 15 L. Assuming the temperature has not changed what will be the pressure?

expect P↑

$P_1 = 110 \, lb/in^2$

$V_1 = 24 \, L$

$P_2 = ?$

$V_2 = 15 \, L$

$P_1 V_1 = P_2 V_2$

$110(24) = P_2 (15)$

$P_2 = 176 \, lb/in^2 \, (psi)$

8. An air compressor has a volume of 10 L. What volume of gas is pumped into the tank if the pressure goes from 14.5 psi to a pressure of 145 psi?

expect V↓

$P_1 = 14.5 \, psi$

$V_1 = ?$

$P_2 = 145 \, psi$

$V_2 = 110 \, L$

$P_1 V_1 = P_2 V_2$

$14.5(V_1) = 145 (110)$

$14.5(V_1) = 15,950$

$V_1 = 1,100 \, L$

WS14-1BoylesLaw