Chemistry Worksheet
Gas Law Problems

Name Mr. Peterson

1. A quantity of gas under pressure of 800 mm Hg has a volume of 380 liters. What is the volume at standard pressure? (temperature held constant)

$P_1 = 800$ mm Hg → 760 mm Hg $= P_2$
$V_1 = 380$ L $V_2 = ?$

$800 \text{ mm Hg} \cdot 380 \text{ L} = 760 \text{ mm Hg} \cdot V_2$
$304{,}000 = 760 \cdot V_2$
$V_2 = 400$ L

2. A quantity of gas has volume of 120 liters when confined under a pressure of 700 mm Hg at a temperature of 20 °C. At what pressure will its volume be 30 liters?

$V_1 = 120$ L $V_2 = 30$ L
$P_1 = 700$ mm Hg $P_2 = ?$
$T_1 = 20°C = 293K$ T_1 = Not Given ⇒ So we can ignore T

$120 \text{ L} \cdot 700 \text{ mm Hg} = 30 \text{ L} \cdot P_2$
$84{,}000 = 30 \cdot P_2$
$P_2 = 2800$ mm Hg

3. At constant pressure, the volume of a gas is increased from 150 liters to 300 liters by heating it. If the original temperature of the gas was 20 °C what will its final ~~Celsius~~ temperature be?

P_1 = Constant ⇒ So ignore P_1/P_2
$V_1 = 150$ L $V_2 = 300$ L
$T_1 = 20°C = 293K$ $T_2 = ?$

$\frac{150 \text{ L}}{293K} = \frac{300 \text{ L}}{T_2} \Rightarrow$
$T_2 = 586$

Don't worry about going back to °C

4. A quantity of gas exerts a pressure of 740 mm Hg at a temperature of 22 °C. If the volume remains unchanged, what pressure will it exert at –8°C?

$P_1 = 740$ mm Hg $P_2 = ?$
$T_1 = 22°C = 295K$ $T_2 = -8°C = 265K$

$\frac{740 \text{ mm Hg}}{295K} = \frac{P_2}{265K}$
$P_2 = 664.7$ mm Hg

5. A quantity of oxygen gas has a volume of 850 mL when measured at 27 °C and 730 mm Hg of pressure. Determine its volume at STP.

$V_1 = 850$ mL $V_1 = ?$
$T_1 = 300K = 27°C$ $T_1 = 273K$
$P_1 = 730$ mm Hg $P_2 = 760$ mm Hg

$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

$\frac{850 \cdot 730}{300} = \frac{760 \cdot V_2}{273K}$
$V_2 = 742$ mL

$2068.3 = \frac{760 \cdot V_2}{273} \Rightarrow 564{,}655 = 760 \cdot V_2$

6. When measured at STP, a quantity of gas has a volume of 500 Liters. What volume will it occupy at 0 °C and 700 mm Hg?

STP → $P_1 = 760$ mm Hg, $V_1 = 500$ L, $T_1 = 273$ K

$P_1 = 700$ mm Hg, $V_2 = ?$, $T_2 = 273$ K

$$\frac{760 \cdot 500}{273} = \frac{700 \cdot V_2}{273}$$

or

$$760 \cdot 500 = 700 \cdot V_2$$

$V_2 = 542$ L

7. A quantity of gas has a volume of 200 L at 17 °C and 800 mm Hg of pressure. To what temperature must this gas be cooled for its volume to be reduced to 150 L at a pressure of 740 mm Hg.

$V_1 = 200$L, $T_1 = 290$K, $P_1 = 800$ mm Hg

$V_2 = 150$L, $T_2 = ?$, $P_2 = 740$ mm Hg

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \Rightarrow \frac{200 \cdot 800}{290} = \frac{150 \cdot 740}{T_2}$$

$T_2 = 201$ K

8. A gas whose behavior closely resembles that of an ideal gas has a volume of 2.00 L at a temperature of 27 C and a pressure of 900 mm Hg. How many moles of molecules are in the sample?

→ 120 kPA

$PV = nRT$

$120 \text{ kPA} \cdot 2.0\text{L} = n \cdot 8.31 \cdot 300\text{K} \Rightarrow$

$240 = 2493n$

$n = .096$ mol gas

9. A sample of nitrogen gas is collected over water at 18.5 °C. The vapor pressure of water at 18.5 °C is 16 mm Hg. What are the partial pressures of nitrogen and of water if the total pressure is 745 mm Hg?

Total Pressure = 745 mm Hg from $N_2 + H_2O$

Partial Pressure from $H_2O = 16$ mm Hg

Partial Pressure $N_2 = 745 - 16 = 729$ mm Hg

Gas Law Review Sheets

Name _____

Abbreviations:
Atm – atmosphere
mm Hg – millimeters of mercury
kPa - kiloPascals
K – Kelvin
°C – degrees Celsius

Conversions:
$K = C^\circ + 273$

Standard conditions
0.00 °C = 273 K
1.0 atm = 760.0 mm Hg = 101.3 kPa

1. A gas occupies 12.3 liters at a pressure of 40.0 mm Hg. What is the volume when the pressure is increased to 60.0 mm Hg?

$P_1V_1 = P_2V_2$

$40\ mm\ Hg \cdot 12.3\ L = 60.0\ mm\ Hg \cdot V_2$

$V_2 = 8.2\ L$

2. If a gas at 25.0 °C occupies 3.60 L at a pressure of 1.00 atm, what will be its volume at a pressure of 2.50 atm?

$P_1V_1 = P_2V_2$

$1.00\ atm \cdot 3.60\ L = 2.50\ atm \cdot V_2$ $\quad V_2 = 1.44\ L$

3. A container holds three gases: oxygen, carbon dioxide, and helium. The partial pressures of the three gases are 2.00 atm, 3.00 atm, and 4.00 atm respectively. What is the total pressure inside the container?

$P_T = P_1 + P_2 + P_3$

$= 2.00\ atm + 3.00\ atm + 4.00\ atm = 9.00\ atm$

4. Determine the pressure change when a constant volume of gas at 1.00 atm is heated from 20.0°C to 30.0° C.

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$ $\quad \frac{1.00\ atm}{293\ K} = \frac{P_2}{303\ K}$ $\quad P_2 = 1.03\ atm$

5. Calculate the decrease in temperature when 2.00 L at 20.0°C is compressed to 1.00 L?

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\quad \frac{2.0\ L}{293\ K} = \frac{1.00\ L}{T_2}$ $\quad T_2 = 146.5\ K$

$= -126.5\ ^\circ C$

6. A gas occupies 11.2 L at .860 atm/ What is the pressure if the volume becomes 15.0 L?

$P_1V_1 = P_2V_2$

$.860\ atm \cdot 11.2\ L = P_2 \cdot 15.0\ L$

$P_2 = 0.642\ atm$

7. 500.0 mL of a gas is collected at 745.0 mm Hg. What will the volume be at standard pressure?

$P_1V_1 = P_2V_2$

$745.0\ mm\ Hg \times 500.0\ ml = 760.0\ mm\ Hg \cdot V_2$

$V_2 = 490.1\ mL$