Advanced Chemistry
Gas Law Problems

NAME: Key **PER:** _____

Instructions: Carry out the following law problems. SHOW ALL WORK in the empty space below the questions. Write the final answer on the blanks provided. Remembers the units. If needed, round to the ~~nearest tenths place~~. Correct sig figs

Boyle's Law $P_1V_1 = P_2V_2$

1. Four liters of carbon dioxide have a pressure of 1.5 atmospheres (atm). If the original pressure was 0.9 atmospheres (atm), what was the original volume?

$P_1 = 0.9\text{atm}$
$V_1 = x$
$P_2 = 1.5\text{atm}$
$V_2 = 4\text{L}$

$(0.9)(x) = (1.5)(4)$

$\frac{0.9x = 6}{0.9}$

$x = 6.\overline{6}$

1 sig fig

1. 7 L

2. 3 gallons of argon were at a pressure of 14 pounds per square inch. A pressure change then reduces the volume to 2.2 gallons. What is the new pressure?

$P_1 = 14\ \text{lb/in}^2$
$V_1 = 3\text{gal}$
$P_2 = x$
$V_2 = 2.2\text{gal}$

$(14)(3) = (x)(2.2)$

$\frac{42 = 2.2x}{2.2}$

$x = 19.0\overline{9}$

1 sig fig

2. 20 lb/in^2

3. A gas occupies 1.56 L at 1.00 atm. What will be the volume of this gas if the pressure becomes 3.00 atm?

$P_1 = 1.00\text{atm}$
$V_1 = 1.56\text{L}$
$P_2 = 3.00\text{atm}$
$V_2 = x$

$(1.00)(1.56) = (3.00)(x)$

$\frac{1.56 = 3.00x}{3}$

$x = .52$

3 sig fig

3. 0.520 L

4. A gas occupies 11.2 liters at 0.860 atm. What is the pressure if the volume becomes 15.0 L.

$P_1 = 0.860\text{atm}$
$V_1 = 11.2\text{L}$
$P_2 = x$
$V_2 = 15.0\text{L}$

$(.860)(11.2) = (x)(15.0)$

$\frac{9.632 = 15x}{15}$

$x = .64213$

3 sig fig

4. .642 atm

5. ~~13~~. A gas occupies 4.31 liters at a pressure of 0.755 atm. Determine the volume if the pressure is increased to 1.25 atm.

$P_1 = .755\text{atm}$
$V_1 = 4.31\text{L}$
$P_2 = 1.25\text{atm}$
$V_2 = x$

$(0.755)(4.31) = (1.25)(x)$

$\frac{3.25405 = 1.25x}{1.25}$

$x = 2.60324$

3 sig fig

5. 2.60 L

$\frac{V_1}{T_1} = \frac{V_2}{12}$ **Charles' Law**

6. The temperature inside my refrigerator is about 4° Celsius. If I place a balloon in my fridge that initially has a temperature of 22° C and a volume of 0.5 liters, what will be the volume of the balloon when it is fully cooled by my refridgerator?

$V_1 = 0.5L$
$T_1 = 22°C + 273.15 = 295.15$
$V_2 = x$
$T_2 = 4°C + 273.15 = 277.15$

$\frac{0.5}{295.15} = \frac{x}{277.15}$

$\frac{138.575 = 295.15x}{295.15}$

$x = .4695070303$

1 sig fig

6. .5 L

7. A man heats a balloon in the oven. If the balloon initially has a volume of 0.4 liters and a temperature of 20°C, what will be the volume of the balloon be after he heats it to a temperature of 250 °C?

$V_1 = .4L$
$T_1 = 20°C + 273.15 = 293.15$
$V_2 = X$
$T_2 = 250°C + 273.15 = 523.15$

$\frac{.4}{293.15} = \frac{X}{523.15}$

$\frac{293.15x = 209.26}{293.15}$

$X = .7138325809$

1 sig fig

7. 0.7 L

8. On hot days, you may have noticed that potato chips bags seem to "inflate", even though they have not been opened. If I have a 250 mL bag at a temperature of 19°C, and I leave it in my car which has a temperature of 60°C, what will the new volume of the bag be?

$V_1 = 250mL$
$T_1 = 19 + 273.15 = 292.15$
$V_2 = X$
$T_2 = 60°C + 273.15 = 333.15$

$\frac{250}{292.15} = \frac{X}{333.15}$

$\frac{292.15x = 83287.5}{292.15}$

$X = 285.0847168$

1 sig fig

8. 300 mL

9. A soda bottle is flexible enough that the volume of the bottle can change even without opening it. If you have an empty soda bottle with a volume of 2 liters at room temperature (25°C), what will the new volume be if you put it in your freezer (-4°C)?

$V_1 = 2L$
$T_1 = 25°C + 273.15 = 298.15$
$V_2 = X$
$T_2 = -4 + 273.15 = 269.15$

$\frac{2}{298.15} = \frac{x}{269.15}$

$\frac{298.15x = 538.3}{298.15}$

$X = 1.805467047$

1 sig fig

9. 2 L

10. How hot will a 2.3-liter balloon have to get to expand to a volume of 400 liters? Assume that the initial temperature of the balloon is 25°C.

$V_1 = 2.3L$
$T_1 = 25 + 273.15 = 298.15$
$V_2 = 400L$
$T_2 = X$

$\frac{2.3}{298.15} = \frac{400}{X}$

$\frac{2.3x = 119260}{2.3}$

$X = 51852.17391$

1 sig fig

10. 50000 K

$\frac{V_1}{n_1} = \frac{V_2}{n_2}$

Avogadro's Law

11. A sample of gas occupies 2.00 L with 5.00 moles present. What would happen to the volume if the number of moles is increased to 10.0?

$V_1 = 2.00\,L$
$n_1 = 5.00\,mol$
$V_2 = X$
$n_2 = 10.0\,mol$

$\frac{2}{5} = \frac{X}{10}$

$X = 4$

$\frac{5X = 20}{5}$

increased to → 4.00 L (3 sig fig)

11. 4.00 L

12. What happened to the number of moles of gas in a sample that originally occupied 500 mL with 2.50 moles and then occupied 750 mL?

$V_1 = 500\,mL$
$n_1 = 2.50\,mol$
$V_2 = 750\,mL$
$n_2 = X$

$\frac{(500)}{2.50} = \frac{750}{X}$

$X = 3.75$

increased to 4 mol

$\frac{500X = 1875}{500}$

12. 4 mol (1 sig fig)

13. 5.00 L of a gas is known to contain 0.965 mol. If the amount of gas is increased to 1.80 mol, what new volume will result?

$V_1 = 5.00\,L$
$n_1 = .965\,mol$
$V_2 = X$
$n_2 = 1.80\,mol$

$\frac{5.00\,L}{.965\,mol} = \frac{X}{1.80}$

$X = 9.32642487$

$\frac{.965X = 9}{.965}$

13. 9.33 L (3 sig fig)

14. A cylinder with a movable piston contains 2.00 g of helium, He, at room temperature and a pressure of 2.00 L. More helium was added to a cylinder and the volume changed to 2.70 L. How much helium was added?

$V_1 = 2.00\,L$
$n_1 = 0.499675211\,1$
$V_2 = 2.70\,L$
$n_2 = X$

$\frac{2}{0.499675211\,1} = \frac{2.70}{X}$

$0.674561535\,mol - 0.499675211\,1\,mol$
$0.174886323\,9$

$\frac{2X = 1.34912307}{2}$

$X = 0.674561535\,mol$

$2.00\,g\,He \times \frac{1\,mol\,He}{4.0026\,g\,He} = 0.499675211\,1$

14. 0.175 mol added (3 sig fig)

15. If 0.00810 mol neon gas at a particular temperature and pressure occupies a volume of 214 mL, what volume would 0.00684 mol neon gas occupy under the same conditions?

$V_1 = 214\,mL$
$n_1 = 0.00810\,mol$
$V_2 = X$
$n_2 = 0.00684\,mol$

$\frac{214}{.00810} = \frac{X}{0.00684}$

$X = 180.7\overline{1}$

$\frac{.00810X = 1.46376}{.00810}$

15. 181 mL (3 sig fig)

Advanced Chemistry
Combined/Ideal Gas Law WS

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Combined Gas Law

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

1. If I initially have a gas at a pressure of 12.0 atm, a volume of 23.0 liters, and a temperature of 200.0 K, and then I raise the pressure to 14 atm and increase the temperature to 300.0 K, what is the new volume of the gas?

$P_1 = 12.0\,atm$
$V_1 = 23.0\,L$
$T_1 = 200.0\,K$
$P_2 = 14\,atm$
$V_2 = x$
$T_2 = 300.0\,K$

$\frac{(12)(23)}{200} = \frac{(14)(x)}{300}$

$2800x = 82800$

$\frac{2800x}{2800} = \frac{82800}{2800}$

$x = 29.57142857$

2 sig fig

1. 30. L

2. A gas takes up a volume of 17.0 liters, has a pressure of 2.30 atm, and a temperature of 299 K. If I raise the temperature to 350.0 K and low the pressure to 1.50 atm, what is the new volume of the gas?

$P_1 = 2.30\,atm$
$V_1 = 17\,L$
$T_1 = 299\,K$
$P_2 = 1.50\,atm$
$V_2 = x$
$T_2 = 350.0\,K$

$\frac{(2.30)(17.0)}{299} = \frac{(1.50)(x)}{350.0}$

$13685 = 448.5x$

$\frac{13685}{448.5} = \frac{448.5x}{448.5}$

$x = 30.51282051$

3 sig fig

2. 30.5 L

3. A gas that has a volume of 28.0 liters, a temperature of 45.0°C, and an unknown pressure has its volume increased to 34.5 liters and its temperature decreased to 35.0°C. If I measure the pressure after the change to be 2.00 atm, what was the original pressure of the gas?

$P_1 = x$
$V_1 = 28.0\,L$
$T_1 = 45 + 273.15 = 318.15$
$P_2 = 2.00\,atm$
$V_2 = 34.5\,L$
$T_2 = 35.0°C + 273.15 = 308.15$

$\frac{(x)(28)}{318.15} = \frac{(2)(34.5)}{308.15}$

$8628.2x = 21952.35$

$\frac{8628.2x}{8628.2} = \frac{21952.35}{8628.2}$

$x = 2.544256044$

3 sig fig

3. 2.54 atm

4. If I have a volume of 17.2 liters of gas at a temperature of 67.0°C and a pressure of 88.89 atm, what will be the pressure of the gas if I raise the temperature to 94.0°C and decrease the volume to 12.5 liters?

$P_1 = 88.89\,atm$
$V_1 = 17.2\,L$
$T_1 = 67 + 273.15 = 340.15$
$P_2 = x$
$V_2 = 12.5\,L$
$T_2 = 94 + 273.15 = 367.15$

$\frac{(88.89)(17.2)}{340.15} = \frac{(x)(12.5)}{367.15}$

$561338.5722 = 4251.875x$

$\frac{561338.5722}{4251.875} = \frac{4251.875x}{4251.875}$

$x = 132.0214193$

3 sig fig

4. 132 atm

5. I have an unknown volume of gas at a pressure of 0.500 atm and a temperature of 325 K. If I raise the pressure to 1.20 atm, decrease the temperature to 322 K, and measure the final volume to be 48.8 liters, what was the initial volume of the gas?

$P_1 = 0.500 atm$
$V_1 = X$
$T_1 = 325 K$
$P_2 = 1.2 atm$
$V_2 = 48.8 L$
$T_2 = 322 K$

$\frac{(.5)(x)}{325} = \frac{(1.2)(48.8)}{322}$

$X = 118.2111801$

$161x = 19032$

$\frac{161}{161}$

3sig fig

5. 118 L

6. If I have 2.90 liters of gas at a pressure of 5.50 atm and a temperature of 50.0°C, what will be the temperature of the gas if I decrease the volume of the gas to 2.44 liters and decrease the pressure to 3.00 atm?

$P_1 = 5.50 atm$
$V_1 = 2.9 L$
$T_1 = 50 + 273.15 = 323.15$
$P_2 = 3.00 atm$
$V_2 = 2.44 L$
$T_2 = X$

$\frac{(5.5)(2.9)}{323.15} = \frac{(3)(2.44)}{X}$

$X = 148.3045768$

$15.95x = 2365.458$

$\frac{15.95}{15.95}$

3sig fig

6. 148 K

Ideal Gas Law

$PV = nRT$

7. At what temperature will 0.654 moles of neon gas occupy 12.30 liters at 1.95 atmospheres?

$(1.95)(12.30) = (.654 mol)(0.08206)(x)$

$\frac{23.985}{.05366724} = \frac{0.05366724x}{.05366724}$

$X = 446.9206413$

3sig Fig

7. 447 K

8. If I have an unknown quantity of gas at a pressure of 1.27 atm, a volume of 31.6 liters, and a temperature of 87.4°C, how many moles of gas do I have?

$+273.15$
360.55

$(1.27)(31.6L) = (x)(.08206)(360.55)$

$\frac{40.132}{29.586733} = \frac{29.586733x}{29.586733}$

$X = 1.356418771$

3sig Fig

8. 1.36 mol

9. If I contain 3.00 moles of gas in a container with a volume of 60.6 liters and at a temperature of 400.15 K, what is the pressure inside the container?

$(x)(60.6L) = (3.00 mol)(.08206)(400.15 K)$

$\frac{60.6x}{60.6} = \frac{98.508927}{60.6}$

$X = 1.625559851$

3sig Fig

9. 1.63 atm

PV=nRT

10. If I have 7.77 moles of gas at a pressure of 0.0915 atm and at a temperature of 56.3°C, what is the volume of the container that the gas is in?

$+273.15$ / 329.45

$(0.0915atm)(x) = (7.77mol)(.08206)(329.45)$

* best way to keep 3 sig figs is put in scientific notation

$\frac{0.0915x = 210.0593626}{.0915}$

3 sig Fig

$x = 2295.730739$

10. 2.30×10^3 L

11. A sample of argon gas **at STP** occupies 56.2 liters. Determine the number of moles of argon.

Temp = 273.15 K
P = 1.00 atm

$(1.00)(56.2) = (x)(.08206)(273.15)$

$\frac{56.2 = 22.4114689x}{22.414689}$

$x = 2.507284397$

3 sig fig

11. 2.51 mol

12. Determine the volume occupied by 0.0532 moles of carbon dioxide gas **at STP.**

Temp = 273.15 K
P = 1.00atm

$(1.00)(x) = (.0532mol)(.08206)(273.15)$

$1x = 1.192461455$

3 sig Fig

12. 1.19 L