Name
Chemistry
Combined Gas Law (a)

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

1. A 1 Liter rigid gas cylinder with a pressure of 1.00 atm has its temperature increased from 298K to 398K. What is the new pressure?

V_1 – same P_1 T_1 T_2

$\frac{1\,atm}{298K} = \frac{P_2}{398K}$ $P_2 = 1.34\,atm$

2. A balloon with a volume of 1 liter at room temperature (25°C) is decreased to -175°C. What is the new volume?

V_1 $T_1 = 298K$ $T_2 = 98K$

$\frac{1L}{298} = \frac{V_2}{98K}$ $V_2 = 0.33\,L$

3. A 5L weather balloon rises up into the air where the pressure has dropped from 1 atm to .75 atm. What is the new volume?

V_1 P_2 $(5L)(1atm) = V_2(0.75atm)$

$V_2 = 6.67\,L$

4. A 2L rigid container at 1 atm is heated from 25°C to 500°C what is the new pressure inside the container?

P_1 298K 673K

$\frac{1atm}{298K} = \frac{P_2}{673K}$ $P_2 = 2.26\,atm$

5. A rigid container has a temperature at 0°C is increased to 25°C. If the original pressure was 600 torr what is the new pressure?

273K 298K P_1

$\frac{600torr}{273K} = \frac{P_2}{298K}$ $P_2 = 655\,torr$

6. What temperature will cause a 1 gallon balloon, at STP, to be compressed to 1L. (STP = 1 atm & 0°C)

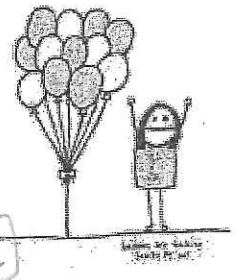
273

$V_1 = 1\,Gallon = 3.79L$

$V_2 = 1L$

$T_1 = 0°C = 273K$

$\frac{3.79L}{273K} = \frac{1L}{T_2}$ $T_2 = 72K$



7. A balloon has a volume of 2L at STP. The balloon is released and floats up into the atmosphere causing the temperature drop by 35°C and the pressure to 620mmHg. What is the new volume?

$V_1 = 2L$ $V_2 = ?$

$T_1 = 273K$ $T_2 = 238K$

P_1 760mmHg

P_2 620mmHg

$\frac{(760mmHg)(2L)}{273} = \frac{(620mmHg)V_2}{238}$ $V_2 = 2.14\,L$

8. A .5L bottle of soda with a pressure of 1.5atm will explode at 8 atm. If the bottle starts at 23°C, what temperature will it explode at?

$T = 23 + 273 = 296K$ $T_2 = ?$

$V = 0.5L$

$P_1 = 1.5\,atm$ $P_2 = 8atm$

$\frac{1.5atm}{296} = \frac{8atm}{T_2}$ $T_2 = 1579K$

9. Two balloons at STP, one Carbon dioxide and one He have a volume of 1.23L. What properties, if any will be different between the two balloons?

mass

He $1.23L \left|\frac{1mol}{22.4L}\right| \frac{4g\,He}{1mol} = 0.22g$ CO_2 $1.23L \left|\frac{1mol}{22.4L}\right| \frac{44g}{mol} = 2.4g$

↓ mass, ↑ vel ↑ mass & vel.

KE = temp $KE = \frac{1}{2}m \cdot v^2$

(#7-3b)
Chemistry

atm L mol K

$$PV = nRT$$

1. Determine the number of moles present in a red balloon that has a volume of 1.5L at STP

V

P = 1 atm T = 273K

$\frac{PV}{RT} = \frac{nRT}{RT}$ $n = \frac{PV}{RT} = \frac{(1\,atm)(1.5\,L)}{(0.0821\,\frac{atm\cdot L}{mol\cdot K})(273K)} = 0.067\,mol$

2. What is the temperature of a sample of air that has a pressure of 1.5 atm, moles = .05 and a volume of 1.1 L.

$\frac{PV}{nR} = \frac{nRT}{nR}$ $T = \frac{PV}{nR} = \frac{(1.5\,atm)(1.1\,L)}{(0.05\,mol)(0.0821\,\frac{atm\cdot L}{mol\cdot K})} = 402\,K$

3. If a balloon has a temperature of 298K and a volume of 1.98L, what is the pressure if the balloon contains 1 mole of gas?

$\frac{PV}{V} = \frac{nRT}{V} = \frac{(1\,mol)(0.0821\,\frac{atm\cdot L}{mol\cdot K})(298K)}{1.98L} = 12.4\,atm$

4. A balloon filled with He has a volume of 250mL at STP is what is the mass of the He in the balloon?

→ 0.250L

4 g/mol

$n = \frac{PV}{RT} = \frac{(1\,atm)(0.025L)}{(0.0821\,\frac{atm\cdot L}{mol\cdot K})(273K)} = 0.0011\,mol \left|\frac{4g}{1\,mol}\right. = 0.0045\,mol\ He$

5. A 1500mL rigid container contains .75 moles of N_2 at 25°C. What is the pressure in atmospheres?

→ 1.500L → +273 = 298

$P = \frac{nRT}{V} = \frac{(0.75\,mol)(0.0821\,\frac{atm\cdot L}{mol\cdot K})(298K)}{1.5L} = 12.2\,atm$

6. What is the pressure in mmHg of a 1 gallon rigid container with a temperature of 212°F and 4 grams of helium?

1 gal = 3.8L

→ 0°K + 273 = 273K

4g He = 1 mol

$P = \frac{nRT}{V} = \frac{(1\,mol)(0.0821\,\frac{atm\cdot L}{mol\cdot K})(273)}{3.8L} = 5.9\,atm$

7. A clown puts 15 grams of Nitrogen in a balloon at STP. What is the volume of the balloon?

$15\,g\ N_2 \left|\frac{1\,mol}{28\,g}\right. = 0.54\,mol$

$V = \frac{nRT}{P} = \frac{(0.54\,mol)(0.0821\,\frac{atm\cdot L}{mol\cdot K})(273K)}{1\,atm} = 12.0\,L$

8. An empty pop bottle has a volume of 591mL. Assuming the bottle is filled with only nitrogen, what is the mass of the air in the bottle at STP?

$n = \frac{PV}{RT} = \frac{(1\,atm)(0.591L)}{(0.0821\,\frac{atm\cdot L}{mol\cdot K})(273K)} = 0.027\,mol$

$0.027\,mol\ N_2 \left|\frac{28\,g}{mol}\right. = 0.75\,g\ N_2$

Name
Chemistry
IDEAL GAS LAW A

$PV = nRT$

Combined Gas Law
$P_1V_1/T_1 = P_2V_2/T_2$
T = Kelvin

1. What is the difference between an Ideal gas and a non-ideal gas?
We make assumptions to estimate variables in an ideal gas... that gas particles travel fast, are very far apart, collisions are elastic & there are no attractions or repulsions

2. What is the combined gas law? $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

3. The combined gas law is simply the combination the these three gas laws?
Boyles Law ($P_1V_1 = P_2V_2$), Charles Law ($\frac{V_1}{T_1} = \frac{V_2}{T_2}$) Gay Lussacs Law ($\frac{P_1}{T_1} = \frac{P_2}{T_2}$)

4. What is the ideal gas law? $PV = nRT$

5. A flask contains $O_{2(g)}$, first at stp and then at 100°C. What is the pressure at 100°C.
STP: $T_1 = 273K$ $T_2 = 373$
$P_1 = 1\ atm$ $P_2 = ?$
$\frac{1\ atm}{273K} = \frac{P_2}{373K}$ $P_2 = 1.37\ atm$

6. Aerosol containers often carry the warning that they should not be heated. Suppose such a container were filled with a gas at 2.5 atm and 22°C, and suppose that the container may rupture if the pressure exceeds 8.0 atm. At what temperature is the rupture likely to occur.
$P_1 = 2.5\ atm$ $P_2 = 8\ atm$
$T_1 = 22 + 273 = 295$ $T_2 = ?$
$\frac{2.5\ atm}{295} = \frac{8\ atm}{x}$
$2.5x = 8(295)$ $x = 944\ K$

7. R is called the universal gas constant. It has a value of .08206(Latm/molK) What is the pressure exerted by 0.508 mol O_2 in a 15.0L container at 303K?
$R = 0.08206\ \frac{L \cdot atm}{mol \cdot K}$ $K = 303K$
$n = 0.508\ mol$ $L = 15.0L$
$P = \frac{nRT}{V} = \frac{(0.508\ mol)(0.08206)(303)}{15}$
$P = 0.84\ atm$

8. What is the volume occupied by 16.0g ethane gas (C_2H_6) at 720 torr (760 T = 1atm) at 18°C? $+273 = 291K$
C 2x12 = 24
H 6x1 = 6
30 g/mol
$16\ g \times \frac{1\ mol}{30\ g}$
$V = \frac{nRT}{P} = \frac{(0.533\ mol)(0.08206\ \frac{atm}{mol\ K})(291\ K)}{1\ atm} = 12.7\ L$

9. What is the temperature, in degrees Celsius, at which 15.0g O_2 will exert a pressure of 785 Torr in a volume of 5 L.
$785\ torr \times \frac{1\ atm}{760\ torr} = 1.03\ atm$
$15\ g\ O_2 \times \frac{1\ mol}{32\ g} = 0.47\ mol$
$T = \frac{PV}{nR} = \frac{(1.03\ atm)(5L)}{(0.47\ mol)(0.08206)}$
$T = 133.5K - 273 = -139°C$

10. Calculation of Molecular mass or molar mass. Other wise known as the mass (g)/ mole. Calculate the molecular mass of a gas if 0.550g of the gas occupies 0.200L at 0.968 atm at 298K.
$PV = nRT$
$n = \frac{PV}{RT} = \frac{(0.968\ atm)(2L)}{(0.08206)(298K)} = 0.079\ mol$
$\frac{0.550\ g}{0.079\ mol} = 7g/mol$

11. The comment arose one day "science has nothing to do with my life". The student, in the next desk over, replied "your breathing aren't you?". With that said, your diaphragm, a muscle just below your lungs contracts and expands with every breath. Explain how this works, and which of out three basic laws explains this?
P = V (Boyles Law)