March 25, 2015

Gas Law Problem

Key

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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?

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

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

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

$\frac{1L}{298} = \frac{V_2}{98K}$ $V_2 = 1.15 \times 10^{-1}\,L$

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?

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

$V_2 = 6.67\,L$

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

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

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

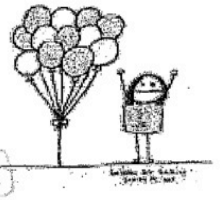
6. What temperature will cause a 1 gallon balloon, at STP, to be compressed to 1L. (STP = 1 atm & 0°C)

$V_1 = 1\,Gallon = 3.79L$

$V_2 = 1L$

$T_1 = 0°C = 273K$

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



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?

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

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?

$T_1 = 23 + 273 = 296K$ $T_2 = ?$

$V = 0.5L$

$P_1 = 1.5atm$ $P_2 = 8atm$

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

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?

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

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1. What is the difference between an Ideal gas and a non-ideal gas?

Ideal gas: (good estimation)
we assume gas particles
-travel fast
-very far apart
-collisions are elastic
-no attractions or repulsions

non ideal gas:
real gases have slightly different parameters and we would have slight differences in values

2. What is the combined gas law?

$$\frac{V_1P_1}{T_1} = \frac{V_2P_2}{T_2}$$

T must be in Kelvin scale

3. The combined gas law is simply the combination the these three gas laws?

Guy-Lussacs Law $\frac{P_1}{T_1} = \frac{P_2}{T_2}$

Boyles Law $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

Charles Law $P_1V_1 = P_2V_2$

Combined Gas Law $\frac{V_1P_1}{T_1} = \frac{V_2P_2}{T_2}$

4. What is the ideal gas law?

$$PV=nRT$$

T must be in Kelvin scale

5. A flask contains $O_{2(g)}$, first at STP and then at 100°C. What is the pressure at 100°C.

T_1= 273K
P_1=1 atm
T_2= 100°C + 273K = 373 K
P_2 = ?

$$\frac{1\text{ atm}}{273\text{K}} = \frac{P_2}{373\text{ K}}$$

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=2.5atm P_2= 8atm
T_1=22+273=295 T_2=?

$\frac{2.5\text{atm}}{295} = \frac{8\text{atm}}{X}$ $2.5X = (8)(295)$ $X = 944\text{K}$

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?

$R = 0.08206\ \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}}$ $K = 303\text{K}$
$n = 0.508\text{mol}$ $L = 15.0\text{L}$

$P = \frac{nRT}{V} = \frac{(0.508\text{mol})(0.08206)(303)}{15}$ $P = 0.84\text{ atm}$

8. What is the volume occupied by 16.0g ethane gas (C_2H_6) at 720 torr (760 T = 1atm) at 18°C? $+273 = 291\text{K}$

$2\times12 = 24$ $6\times1 = 6$ 30g/mol

$V = \frac{nRT}{P} = \frac{(0.533\text{mol})(0.08206\ \frac{\text{atm}\cdot\text{L}}{\text{mol}\cdot\text{K}})(291\text{K})}{1\text{atm}} = 12.7\text{L}$

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.

$785\text{ torr}\ \frac{1\text{atm}}{760\text{ torr}} = 1.03\text{atm}$ $15\text{g}\ O_2\ \frac{1\text{mol}}{32\text{g}} = 0.47\text{ mol}$

$T = \frac{PV}{nR} = \frac{(1.03\text{atm})(5\text{L})}{(0.47\text{mol})(0.08206)}$ $T = 133.5\text{K} - 273 = -139°\text{C}$

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.

$PV = nRT$

$n = \frac{PV}{RT} = \frac{(0.968\text{atm})(2\text{L})}{(0.08206)(298\text{K})} = 0.079\text{mol}$

$\frac{0.550\text{g}}{0.079\text{mol}} = 7\text{g/mol}$

The student arose one day "science has nothing to do with my life". The student in the next desk

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