TH-6C General Chemistry Week 25 3/23

Ideal Gas Law:

$$PV = nRT$$

P = pressure

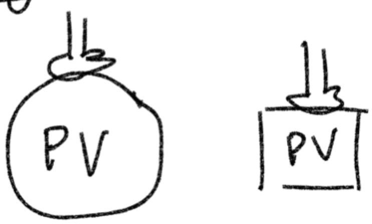
V = volume

n = amount (mol)

R = universal gas constant

T = Absolute Temp (K)

Boyle's Law



$$P_1V_1 = P_2V_2$$

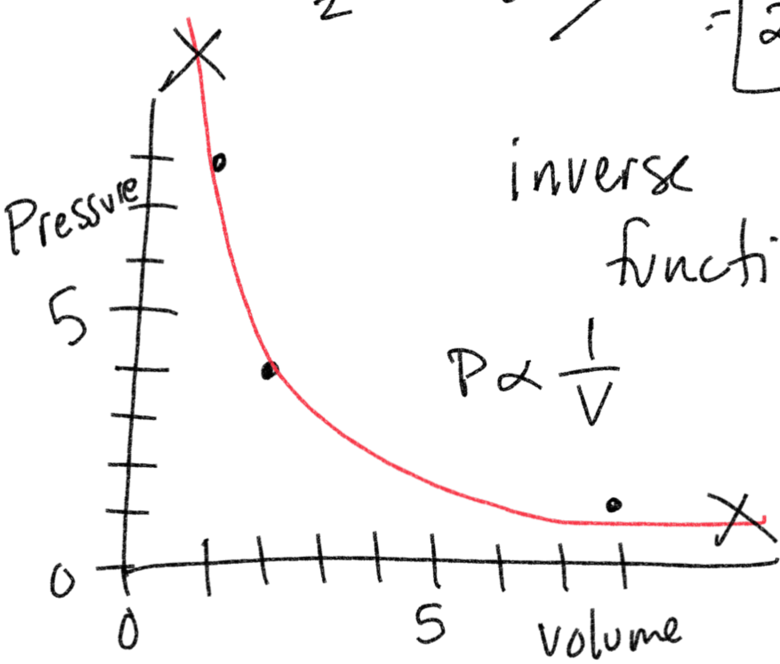
P↑ V↓

P↓ V↑

1.) Gas initially at 3.5 atm and 15 L → transferred to 20 L container, what is the new pressure?

$$\frac{P_1V_1}{V_2} = \frac{P_2V_2}{V_2}$$

$$z = \frac{P_1V_1}{V_2} = \frac{(3.5\,atm)(15\,L)}{20\,L} = \boxed{2.6\,atm}$$



inverse function

$$P \propto \frac{1}{V}$$

$$P_1V_1 = P_2V_2$$

(4)(2) (8)(1)

8

Sample of Cl_2 gas initial volume = 946 mL at a pressure of 726 mmHg.

What is the **pressure** (mmHg) if the volume is reduced to 154 mL at a <u>constant</u> <u>temperature</u>.

PV = constant

$P_1V_1 = P_2V_2$

$\frac{P_1V_1}{V_2} = \frac{\boxed{P_2}V_2}{V_2}$

$P_2 = \frac{P_1V_1}{V_2} = \frac{(726\ mmHg)(946\ mL)}{154\ mL}$

$= \boxed{4460\ mmHg}$

$PV = nRT$ (V ↑, T ↑)

Volume and temperature are proportional

Charle's Law

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

$V_1T_2 = V_2T_1$

A sample of carbon monoxide occupies 3.20 L at 125°C. At what temperature will the gas occupy a volume of 1.54 L if the pressure and amount remain constant?

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T = Absolute Temp

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

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

125 °C
+ 273
398

$$T_2 = \frac{V_2 T_1}{V_1} = \frac{(1.54\ L)(398\ K)}{3.20\ L} = \boxed{192\ K}$$

$V_1 = 700\ mL$ $T_1 = 20°C \rightarrow 20+273 = 293K$

$V_2 = \boxed{}$ $T_2 = 100\ °C \rightarrow 100+273 = 373K$

$$\frac{V_1}{T_1} \times \frac{V_2}{T_2}$$

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

$$V_2 = \frac{V_1 T_2}{T_1} = \frac{(700\ mL)(373K)}{293\ K} = \boxed{891\ mL}$$

Avagadro's Law

Molar Volume = 22.4L

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

Volume is proportional with amount

22.4

$$3H_2(g) + N_2(g) \longrightarrow 2NH_3(g)$$

3 mol   1 mol   2 mol

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

STP → Standard Temperature Pressure

Temperature → 0°C → 273K

Pressure → 1 atm

Volume → 22.4 L

What is the volume (L) occupied by 49.8g of HCl at STP.

R

$$\frac{PV}{P} = \frac{nRT}{P}$$

$$V = \frac{nRT}{P} = \frac{(1.37\,mol)(0.0821)(273K)}{1\,atm}$$

30.7L

molar mass HCl 36.458

$$\frac{49.8g}{36.458\,g/mol} = 1.37\,mol$$