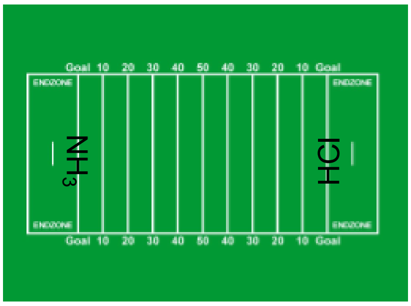
# The Peterson problem




If tanker trucks placed at opposite goal lines, carrying HCl (g) and $NH_3$(g) burst open at the same time, where is the safest place on the field to stand (knowing that together they form a harmless white solid)?

① $$\frac{\sqrt{MM_{HCl}}}{\sqrt{MM_{NH_3}}} = \frac{d_{NH_3}}{t_{NH_3}} \cdot \frac{t_{HCl}}{d_{HCl}}$$

② times are the same so...

$$\frac{\sqrt{MM_{HCl}}}{\sqrt{MM_{NH_3}}} = \frac{d_{NH_3}}{d_{HCl}}$$

③ total distance = 100yds so....

$$\frac{\sqrt{MM_{HCl}}}{\sqrt{MM_{NH_3}}} = \frac{x}{100-x}$$

④ solving ....

$$\frac{\sqrt{36.4606}}{\sqrt{17.0305}} = \frac{x}{100-x}$$

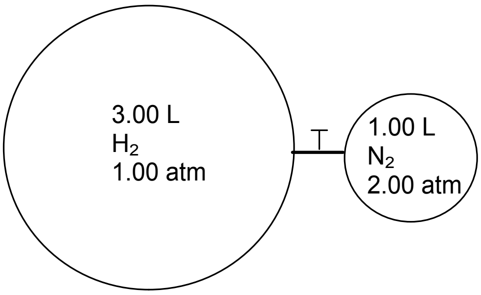
$x = 59.4$ yd (from the $NH_3$ end)

# Dalton's Law

$$P_1 + P_2 + P_3 \ldots = P_{TOTAL}$$

Three types of Dalton's Law Problems

The first type...




What will the final pressure be if the valve is opened?

$H_2$

3.00 L → 4.00 L  V↑ P↓

1.00 atm → ?

1.00 atm × $\frac{3.00\,L}{4.00\,L}$ = .750 atm

$P_1V_1 = P_2V_2$

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

$N_2$

1.00 L → 4.00 L  V↑ P↓

2 atm → ?

2.00 atm × $\frac{1.00\,L}{4.00\,L}$ = 0.500 atm

$P_T = P_{H_2} + P_{N_2}$

= 1.250 atm

The second type:

A container holds 3.5 moles of nitrogen gas, 1.0 moles of hydrogen gas and 1.5 moles of oxygen gas. The total pressure in the container is 4.66 atm. What is the pressure of the oxygen?

3.5 mols $N_2$

1.0 mols $H_2$

1.5 mols $O_2$

4.66 atm

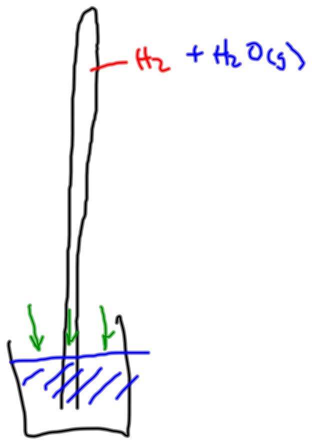
$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$

↑ total ↑ $O_2$

$\frac{P_T}{n_T} = \frac{P_{O_2}}{n_{O_2}}$  $P_{O_2} = \frac{P_T \cdot n_{O_2}}{n_T}$ = 1.16 atm

The third type:

Hydrogen gas is collected over water at an atmospheric pressure of 0.976 atm. If the volume of the gas collected is 27.9 mL and the temperature is 20.8°C, what mass of hydrogen is collected? The vapor pressure of water at 20.8°C is 18.5 mm Hg.




$PV = nRT$

$n = \frac{PV}{RT}$ ← .0279 L; T = (20.8 + 273.15)

n → g

$P_{in} = P_{out}$

$P_{H_2O} + P_{H_2} = P_{atm}$

$P_{H_2} = P_{atm} - P_{H_2O}$

13.6 liters of hydrogen at 1.06 atm and 51°C are burned in oxygen. How many liters of water vapor are produced at 278°C and 2.11 atm?

$2H_2 + O_2 \rightarrow 2H_2O$

$H_2$: 13.6 L, 1.06 atm, 51°C  $H_2O$: ? L, 278 °C, 2.11 atm

$PV = nRT$

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

$$n = \frac{PV}{RT} = \frac{(1.06\,atm)(13.6\,L)}{(R)(324\,K)} \times \frac{2\,H_2O}{2\,H_2} \times \frac{(R)(551\,K)}{2.11\,atm}$$

$n_{H_2O}$

$$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$$

coefficient

When 3.7 liters of $SO_{2\,(g)}$ at 120.7°C and 345 mm Hg react with oxygen at the same temperature and pressure to produce $SO_{3\,(g)}$, what volume of oxygen is required?

$2SO_2 + O_2 \rightarrow 2SO_3$

3.7 L ?L

120.7°C →

345 mm Hg →

$3.7\,L\,SO_2 \times \frac{1\,O_2}{2\,SO_2} =$

Non-ideal behavior - what and why

→ doesn't obey laws / KMT

low T → slower → (SSE) att more effective → collisions R sticky, not straight lines → liquid

high density → less empty space → lose compressibility