Chapter 5 Gases.

Elements that are gases:

H_2 N_2 O_2 F_2 Cl_2 He Ne Ar Kr Xe Rn

Gases

- very compressible
- mix evenly with other gases.
- very low density
- assume shape + volume of container.

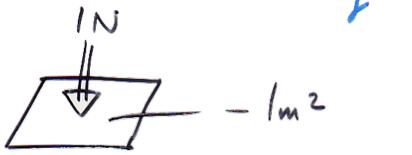
Pressure, P

$$\text{Pressure} = \frac{\text{force}}{\text{Area}}$$

force: Newtons, N

Area: meters squared, m^2

$$\frac{N}{m^2}$$



Pascal

$$P = \frac{1N}{1m^2} = 1\frac{N}{m^2} = 1\,Pa$$

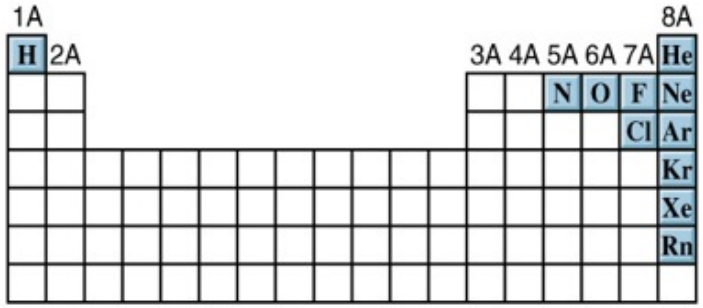
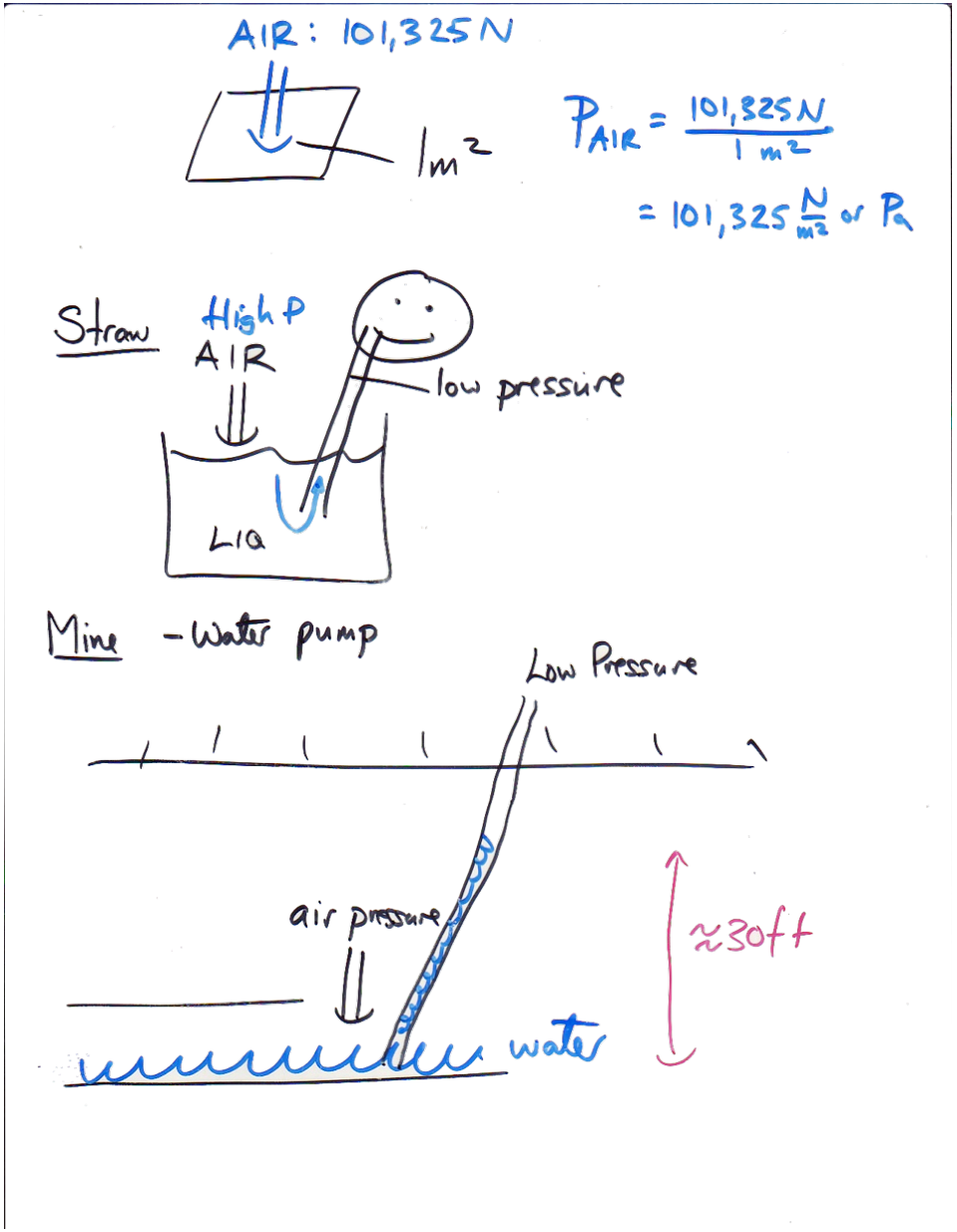
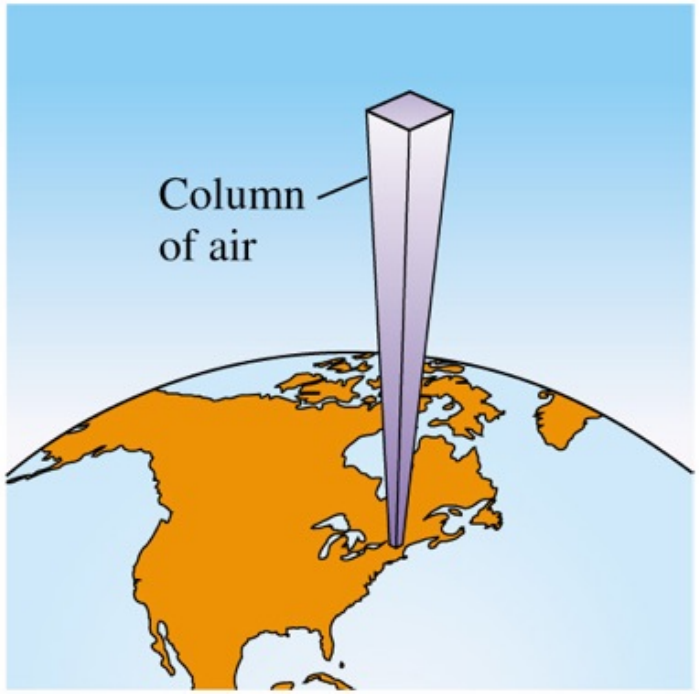


Table 5.1 Some Substances Found as Gases at 1 Atm and 25°C

Elements	Compounds
H_2 (molecular hydrogen)	HF (hydrogen fluoride)
N_2 (molecular nitrogen)	HCl (hydrogen chloride)
O_2 (molecular oxygen)	HBr (hydrogen bromide)
O_3 (ozone)	HI (hydrogen iodide)
F_2 (molecular fluorine)	CO (carbon monoxide)
Cl_2 (molecular chlorine)	CO_2 (carbon dioxide)
He (helium)	NH_3 (ammonia)
Ne (neon)	NO (nitric oxide)
Ar (argon)	NO_2 (nitrogen dioxide)
Kr (krypton)	N_2O (nitrous oxide)
Xe (xenon)	SO_2 (sulfur dioxide)
Rn (radon)	H_2S (hydrogen sulfide)
	HCN (hydrogen cyanide)*

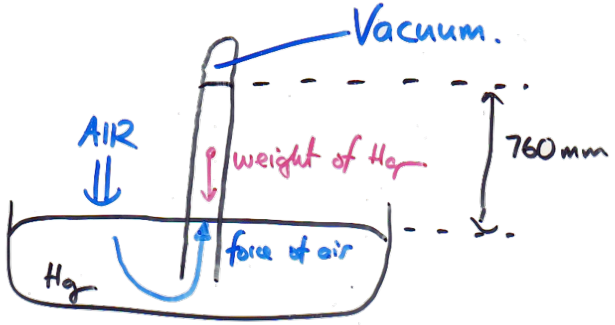
* The boiling point of HCN is 26°C, but it is close enough to qualify as a gas at ordinary atmospheric conditions.





Torricelli

- Barometer



1 atmosphere = average air pressure @ sea level

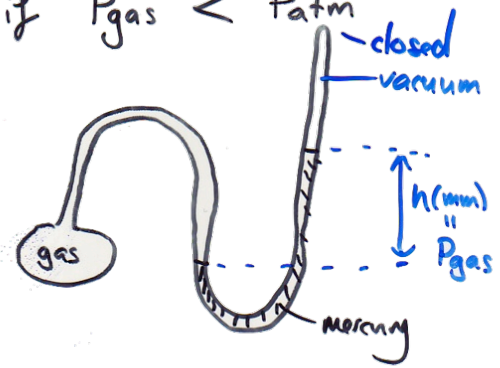
1 atm = 760 mm Hg = 101,325 Pa

= 760 torr

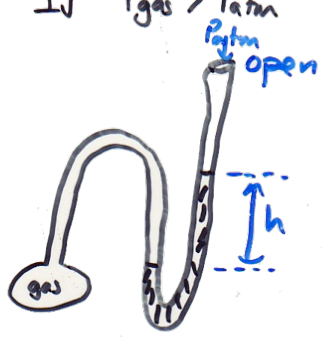
Measuring Pressure of gases

- Use a Manometer

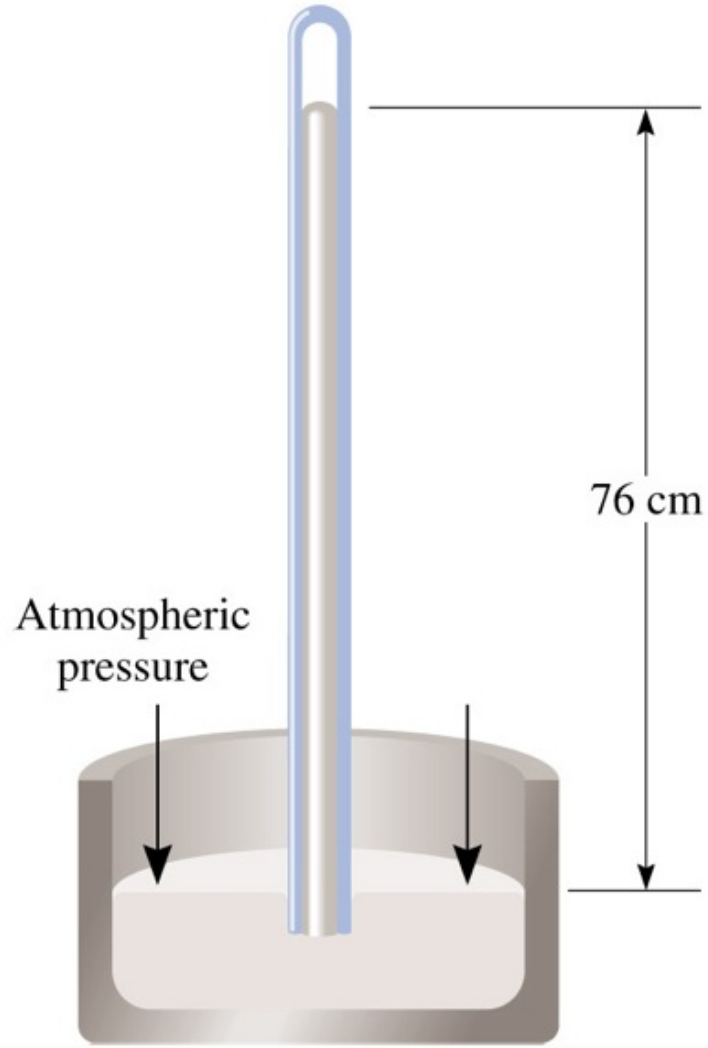
if $P_{gas} < P_{atm}$

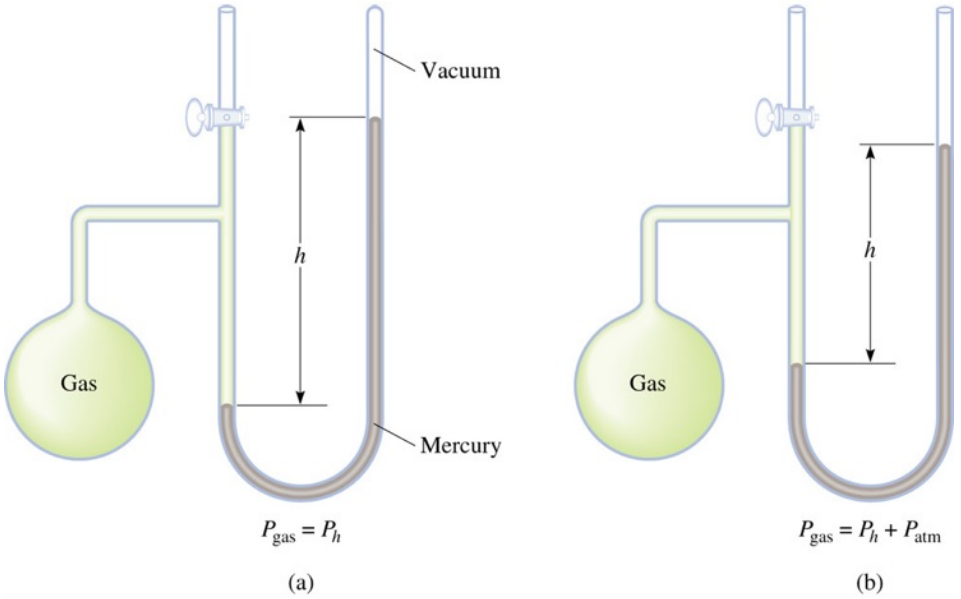


If $P_{gas} > P_{atm}$



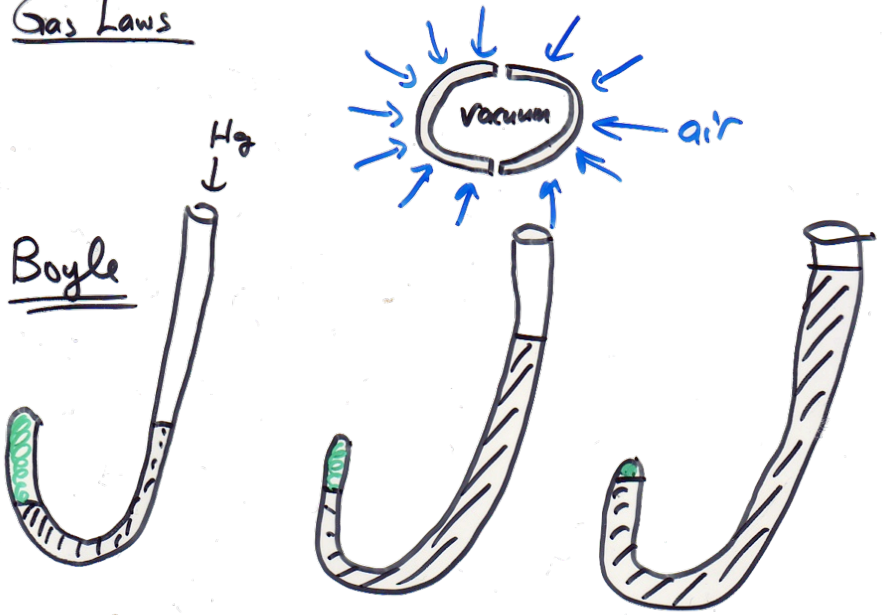
$P_{gas} = P_{atm} + h$





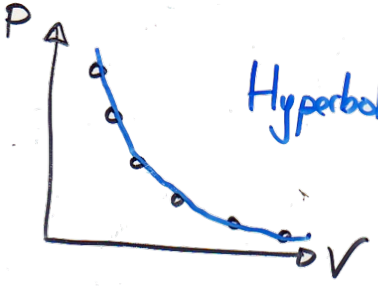
ex: if $h = 110\,mm$, then $P_{gas} = 760\,mm\,Hg + 110\,mm\,Hg = 870\,mm\,Hg$

Gas Laws



Boyle

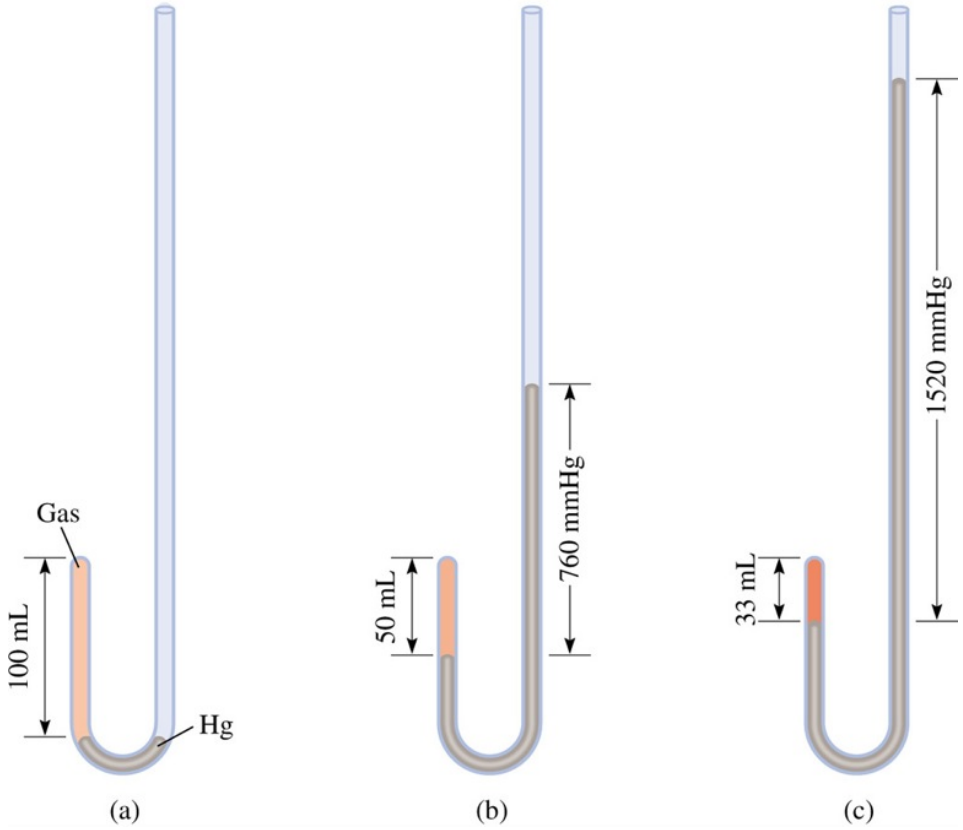
as P↑ V↓

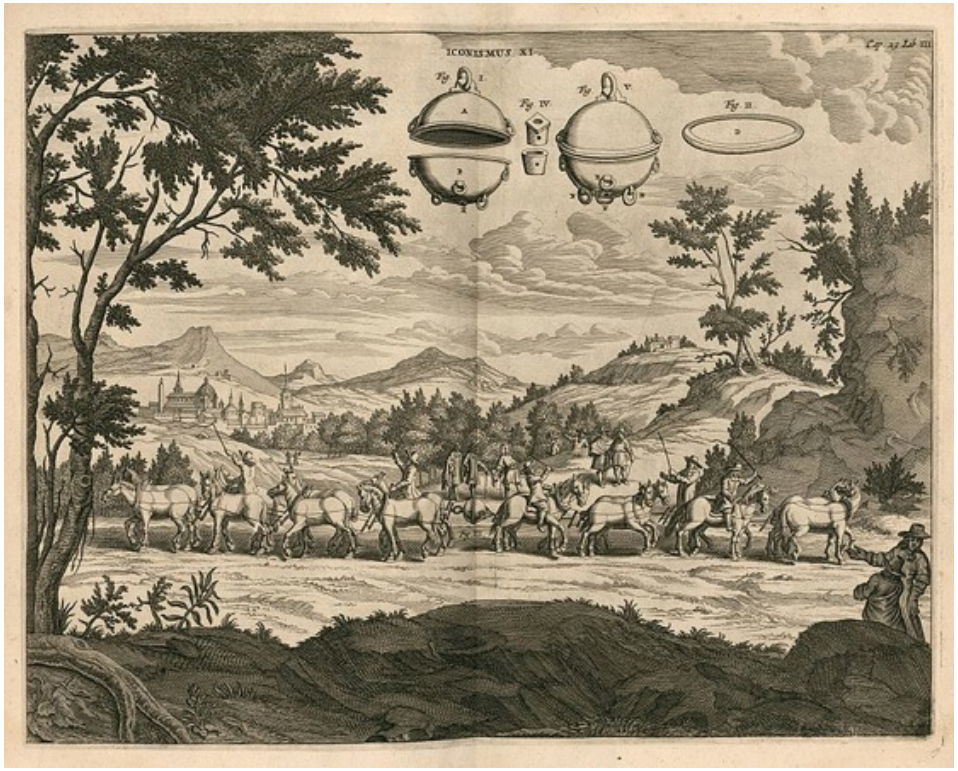


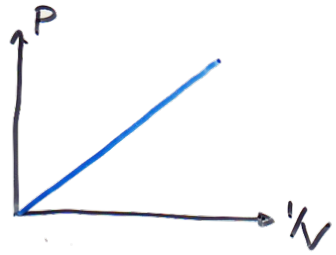
Hyperbola

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

pressure is inversely proportional to volume







$P_1V_1 = P_2V_2$

~~after~~ before after

- assume temp is constant
- amount of gas " —— "

Boyle's Law

P_1V_1 = constant !

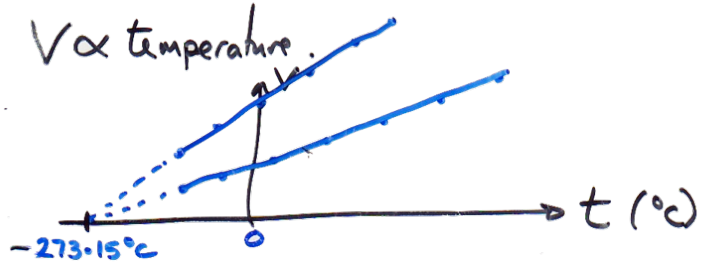
ex: Lungs $P_1 = 1.00\ atm$, $V_1 = 3.00\ L$ → $P_2 = ?$, $V_2 = 4.00\ L$

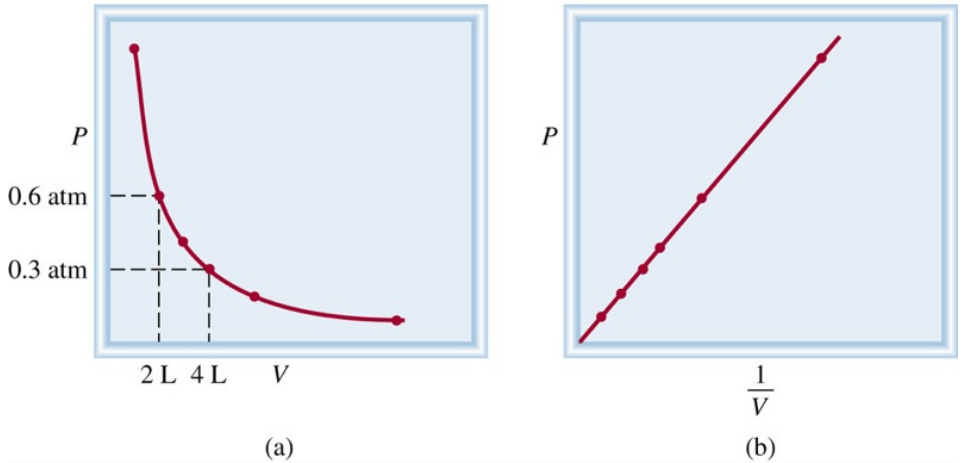
$P_1V_1 = P_2V_2 \Rightarrow P_2 = \frac{P_1V_1}{V_2} = \frac{1.00\ atm \times 3.00\ \cancel{L}}{4.00\ \cancel{L}}$

$= 0.750\ atm$.

Charles

V ∝ temperature.





Absolute temperature scale.

- Lowest possible temperature = 0 Kelvin
  = Ø K ← Absolute zero

°C	°F	°K	K
✓	✓	✗	✓

$T(K) = t(°C) + 273.15$

ex: $t = -273.15\ °C$

$T = -273.15 + 273.15 = 0\ K$

$t = 25.00\ °C$

$T = 25.00 + 273.15 = 298.15\ K$