4/15/20

Molar volume of an ideal gas @ STP

The volume of one mole of a gas

A hypothetical gas that obeys simple laws.

A standard set of conditions.

Producing H_2 gas

(per atom)

$$\overset{0}{Mg}(s) + 2\,\overset{+1}{H}\overset{-1}{Cl}(aq) \rightarrow \overset{0}{H_2}(g) + \overset{+2}{Mg}\overset{-1}{Cl_2}(aq)$$

Mg: 0 to +2 → oxidized

H: +1 to 0 → reduced

Mg is the reducer.

HCl is the oxidizer

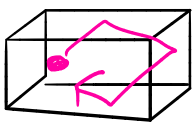
The limiting reagent in this reaction is Mg(s) because HCl(aq) is used in large excess. Therefore the moles of $H_2(g)$ formed will be determined by the moles of Mg(s), if all of the Mg(s) reacts successfully (100% yield).

$$2\,\overset{0}{Mg}(s) + \overset{0}{O_2}(g) \longrightarrow 2\,\overset{+2}{Mg}\overset{-2}{O}(s)$$

Mg(s) naturally reacts with $O_2(g)$ to form a layer of MgO(s) on the outside.

To ensure the correct number of moles of Mg(s) are present, the suface of the Mg(s) should first be sanded with sand paper in order to remove this layer of $MgO_{(s)}$.

Ideal gases



If certain assumptions are made about the behavior of a gas, and gas can be described by the same equation. This hypothetical gas is known as an ideal gas.

characteristics

- gas particles occupy no volume
  → would affect the container volume
- gas particles experience no attractions
  → would affect the pressure
- gas particles do not lose energy when they collide.
  → would affect temperature

$H_2(g)$ is a good gas to use for an ideal gas experiment because the molecules occupy very little volume and have low intermolecular forces (IMF).

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standard temperature and pressure (STP)

— STP is a set of conditions used for comparing the behavior of gases,

(traditional) 0°C and 1 atm ←

(modern) 25°C and 1 bar

Ideal gas law $PV = nRT$

$P_1V_1 = nRT_1$ $\qquad$ $P_2V_2 = nRT_2$

R: gas constant

n: In a closed sample, n is constant

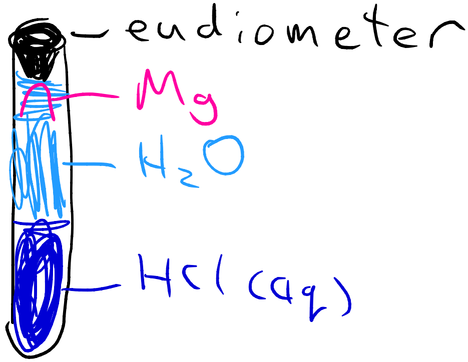
$\frac{P_1V_1}{T_1} = nR$ $\qquad$ $\frac{P_2V_2}{T_2} = nR$

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

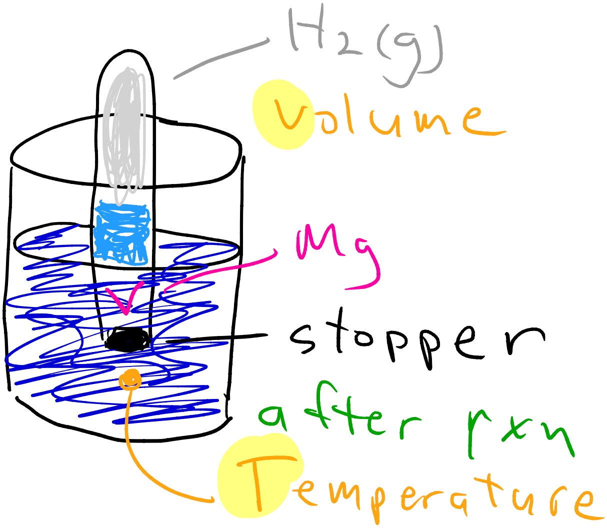
Conditions in lab (what is measured): $\frac{P_1V_1}{T_1}$

STP: $P_2 = 1$ atm, $T_2 = 273$ K

V_2: ideal volume (goal)



before rxn



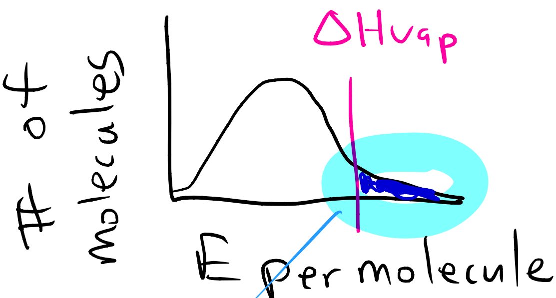
The pressure $= P_T$ (total) is obtained from the De Anza weather station.

Corrections to pressure

$$P_{H_2} = P_T - P_{H_2O} - P_{height}$$

$$P_T = P_{H_2} + P_{H_2O} + P_{height}$$

Vapor pressure of H_2O



At room temperature, some molecules of water have the energy to evaporate.

Weight of water

The weight of water above the level of the beaker contributes to the total pressure.