Boyle’s Law

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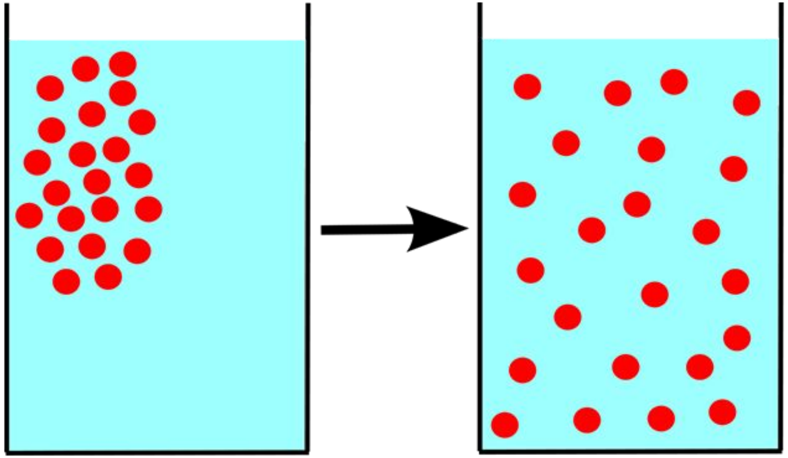
Historical Background

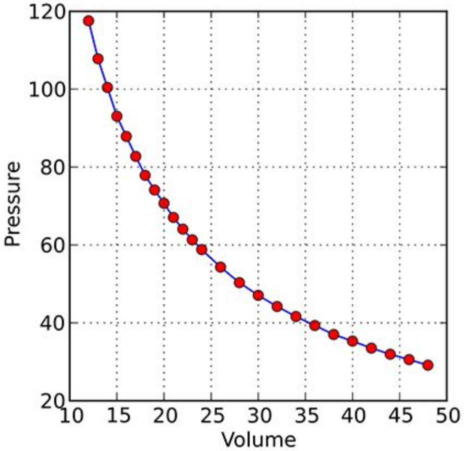
Robert Boyle, born year 1627 and having passed away 1619, was a “17th-century pioneer of modern chemistry” (www.sciencehistory.org). Who had discovered that the volume of a gas decreases with an increase of pressure, it can also be inverted and the same would apply, thus he created, discovered, Boyle’s law.

Difference between real & ideal gases



$$V \alpha \frac{1}{P} \; for \; T = Constant$$

Volume × Pressure = Constant/volume × Pressure = Constant



$$pV = \frac{\text{mass (g)}}{\text{mass of 1 mole (g)}} \times RT$$

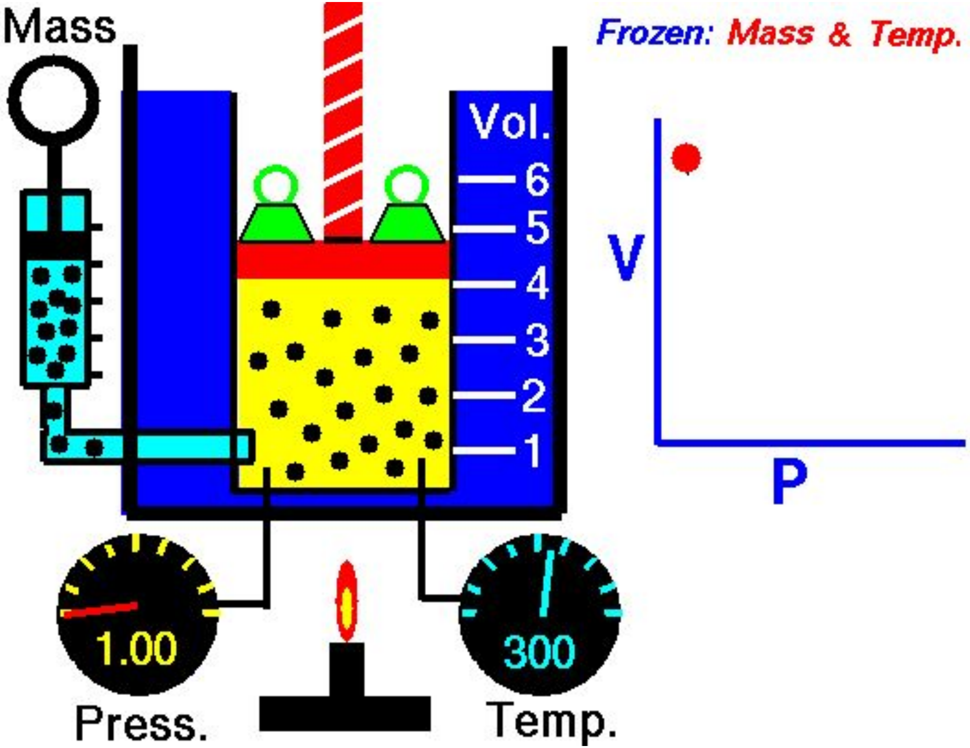
$$101325 \times 0.001 = \frac{1.264}{\text{mass of 1 mole (g)}} \times 8.31441 \times 293$$

$$\text{mass of 1 mole (g)} = \frac{1.264 \times 8.31441 \times 293}{101325 \times 0.001}$$

$$= 30.4 \text{ g}$$

Simulation

http://www.physics-chemistry-interactive-flash-animation.com/matter_change_state_measurement_mass_volume/pressure_volume_boyle_mariotte_law_ideal_gas_closed_system_MCQ.htm



Application -

Filling a tire with air:

Most of the times, we fill a tire with somewhere between 30 to 35 Pounds Per Square Inch (PSI) of compressed air at gas pumps. This displays a measurement of pressure. As we apply more and more compressed air into the tire, this happens as we are pushing together all the gas molecules to stick and build up together, by decreasing their volume and increasing the pressure forcing on the walls inside of the tire. As long as the air temperature remains the same within the tire, we are generally taking this as a real life application of Boyle's law.

Application

A Spray Paint Can:

One of the basic works of spray cans depend on the use of Boyle’s law, no matter what exterior let it be various types of aerosol cans or etc. they all rely on the same exact principle. Whenever we use a spray paint can, the instructions always tell you to shake it thoroughly before using it, when we do this action the ball bearing rattles around the inside of the can. The can is compacted with two substances, one being the paint as the product, another being the gas which is then compressed to an extent that it loses the liquid state. The paint within the can has a boiling point far below room temperature. So, because the can is occlude, the gas within the can is averted from boiling and forming into a gas instead of a liquid, until you push the nozzle of the can. The second the nozzle of the can goes down, the occlude of the can

Application

A Syringe:

The contrivance of a syringe, is way more simpler the bases of a spray can. Various types of syringes uses the Boyle's law application on a very basic and simple level. The way of how this application connects with boyle's law begins when we pull the plunger that pushes into the syringe out, this causes the volume within the interior of the syringe to increase as it happens. Then this causes the pressure to do the opposite, which thus creates a vacuum. When the syringe is empty, the vacuum within space between the plunger and the end, the chamber of the syringe, compacts and sucks fluid in through the needle and lets it out.

Solved Solution #1: Balloon

A Balloon has a volume of 0.55 at sea level at the moment, and is allowed to rise to an altitude of 6.5 km, where the pressure is 0.40 at the same moment.Assume that the temperature remains at a constant, then what is the final volum of the balloon?

V= Volume P= Presure

$P_1 = 1.0$ atm $P_2 = 0.40$ atm

$V_1 = 0.55$ L $V_2 = ?$

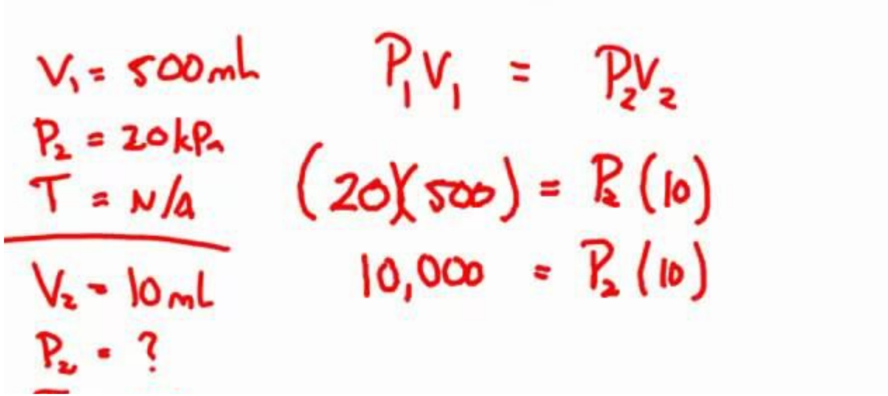
$V_2 = V_1 \times P_1/P_2 = (0.55 \text{ L}) \times (1.0 \text{ atm} / 0.40 \text{ atm})$

$V_2 = \mathbf{1.4\ L}$

Solved Solution #2: Can

A 500 mL can of gas is at a pressure of 20 kPA (kilopascal). If the can is run over by a garbage truck and flattened to a volume of 10 mL, what is the pressure in kPa (kilopascal) assuming the can doesn’t leak?

V=Volume, P= Pressure



Works Cited

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