ChemistryGod

Real-life Examples of Boyle's Law

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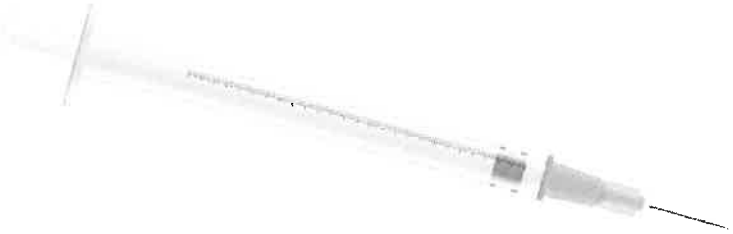
Physical Chemistry

Boyle's law relates the pressure of a gas to its volume. The law was discovered by Robert Boyle in the seventeenth century. He found the pressure of a gas is inversely proportional to its volume at a constant temperature for a fixed amount of the gas. In other words, as the pressure increases, the volume decreases, and vice versa. Although the law is very old, its applications can be observed in our everyday life. Some real-life examples or applications are discussed below.

Syringe

We all have seen a syringe while visiting a doctor. It is a medical device used to inject or withdraw fluid. It consists of a hollow cylinder called a barrel and a sliding plunger attached to it. The working principle of a

syringe is like a reciprocating pump. When the plunger is pushed, the fluid will inject, and when the plunger is pulled, the fluid will withdraw.



Syringe

The pushing of the plunger reduces the volume of the fluid in the barrel. This reduction in the volume causes a momentary increase in the pressure of the fluid, and the fluid is injected into the patient's body. In a similar way, the pulling of the plunger increases the volume of the fluid. It results in a momentary decrease in the pressure of the fluid, and external fluid is withdrawn.

Human lungs

The lungs are an important organ of the body. They play a vital role in the respiratory system. As the lungs expand, there is a momentary reduction in the pressure. Thus, the pressure inside the body is lower than the outside. Consequently, the surrounding air slips in the body. This process is called inhalation.

Human lungs

When the lungs relax, the volume of the lungs decreases, which increases the pressure momentarily relative to the outside. And the air is exhaled from the body.

Bicycle pump

A hand bicycle pump works similar to a syringe. When the handle of a pump is pushed down, the pressure inside the pump will increase momentarily. In other words, the gas inside is compressed. As a result, the pressurized gas is forced inside the tire of a vehicle.

Bicycle pump

Deep-sea fish

The average depth of oceans is around 3000 meters. At such depths, new lifeforms are evolved. The pressure at such depths is tremendous, which makes a normal life survival impossible. But deep-sea creatures are evolved and get accustomed to such harsh environments.

Coccorella atrata, a deep-sea creature

When these lifeforms are brought to the surface of oceans, relatively low-pressure environment, the gases inside their bodies will expand as

per Boyle's law, and they immediately collapses.

The same is true for us. If a human being is dropped into oceans, its body will be crushed by the external pressure at great depths.

Space

In outer space, there is no atmosphere, no air, and no pressure. This state of no pressure is called a vacuum. Thus, any pressurized gas in space will expand infinitely as per Boyle's law. Astronauts in space protect themselves by wearing their spacesuits, which can withstand extreme pressures and temperatures. In case their spacesuits get damage, and their body is exposed to space, they are as good as dead. It is the worst nightmare for them. It's because their blood and other bodily fluids will start boiling on exposure to space.

An astronaut in outer space

The bends

The bends are decompression sickness experienced by scuba divers when they ignore Boyle's law. As a diver dives deep inside water, the surrounding pressure of the water increases. The high pressures increase the solubility of the bodily gases in the blood of the diver.

> Note: Every 10 meters of depth, pressure increases by 1 atm or 14.7 psi.

The deeper a divers goes, the more the quantity of gases dissolves inside the blood of the diver. When he/she ascends, the dissolved gases start expanding since the pressure gets lower. A well-trained diver will always ascend slowly. But if he/she somehow makes a rapid ascent, the diver will suffer in severe pain. The gases in the body of the diver will expand

quickly, making the blood a foamy solution. Moreover, the gases between joints will also expand, which will cause the diver's body to blend. This sometimes can be a life-threatening condition.

A diver in underwater

Air bubbles

Air bubbles expand as they ascend in water. As the bubbles rise, the surrounding pressure of the liquid decreases. And according to Boyle's law, the air bubbles expand.

Air bubbles on the surface of water

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- Graphs of Boyle's law
- To verify Boyle's law experimentally
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