

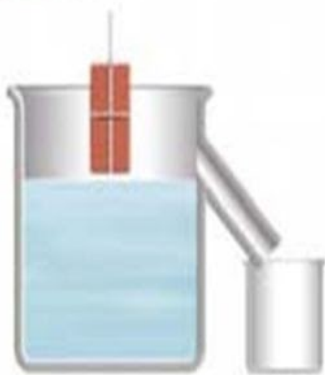
Notes on Scientific Laws and Theories

A Scientific Law is the description of an observed phenomenon. It doesn't explain why the phenomenon exists or what causes it. The explanation of the phenomenon is called a Scientific Theory.

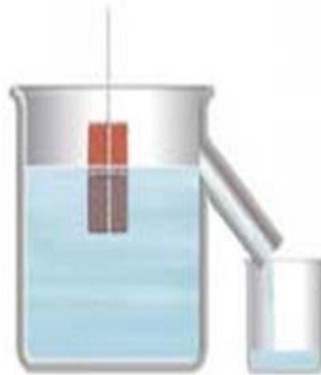
1. Archimede's principle - It states that a body when wholly or partially immersed in a liquid experience an upward thrust which is equal to the weight of the liquid

displaced by it. Thus, the body appears to lose a part of its weight. This loss in weight is equal to the weight of the liquid displaced by the body.

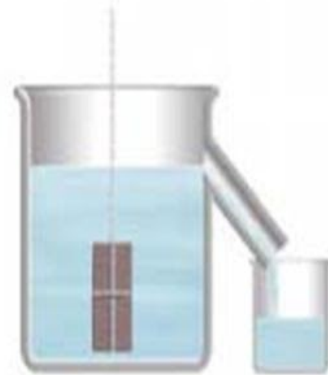
Archimedes' Principle



A An object is lowered into a container of water.



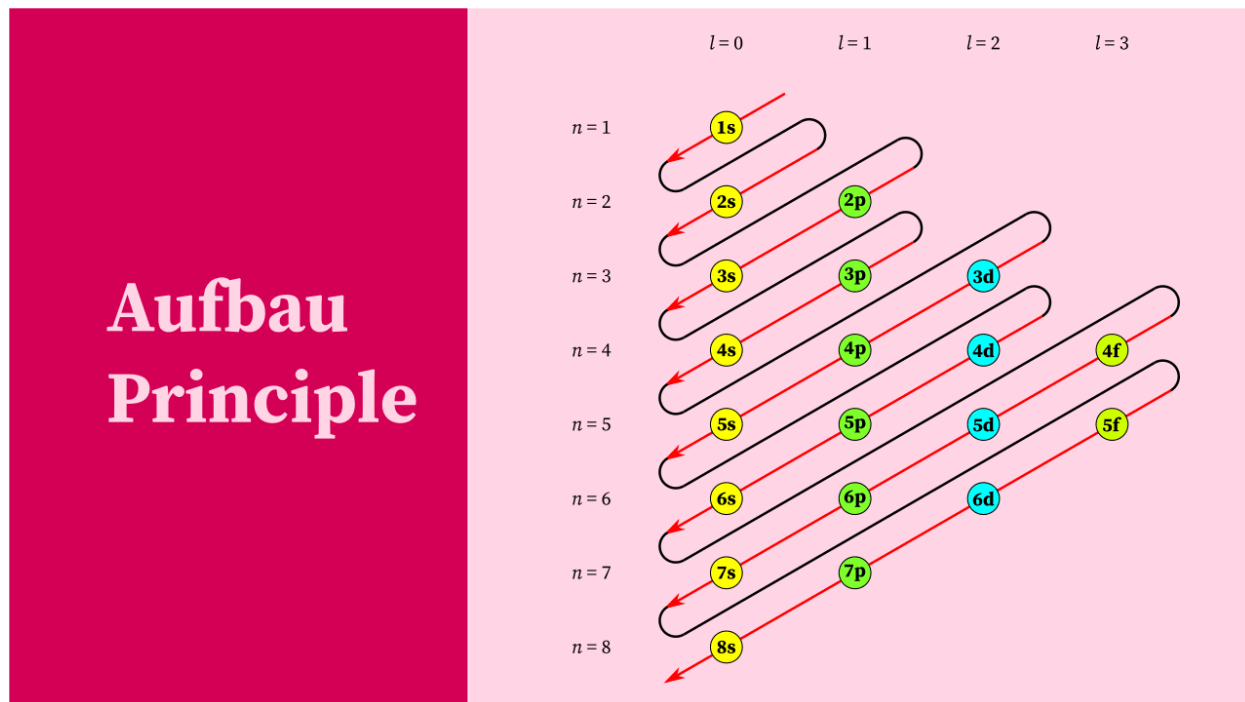
B The object displaces water, which flows into a smaller container.



C When the object is completely submerged, the volume of the displaced water equals the volume of the object.

2. Aufbau principle - The Aufbau principle dictates the manner in which electrons are filled in the atomic orbitals of an atom in its ground state. It states that electrons are filled into atomic orbitals in the increasing order of orbital energy level. According to the

Aufbau principle, the available atomic orbitals with the lowest energy levels are occupied before those with higher energy levels.



3. Avogadro's Law - Avogadro's law, also known as Avogadro's principle or Avogadro's hypothesis, is a gas law which states that the total number of atoms/molecules of a gas (i.e. the amount of gaseous substance) is directly proportional to the volume occupied by the gas at constant temperature and pressure. Avogadro's law is closely related to the ideal gas equation since it links temperature, pressure, volume, and amount of

substance for a given gas.



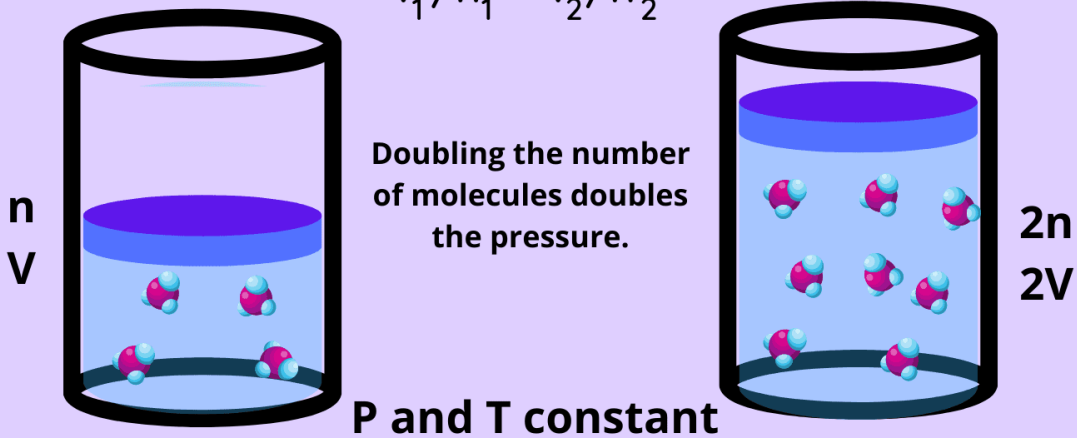
Avogadro's Law



Equal volumes of a gas contain the same number of molecules at the same temperature and pressure.

$$V/n = k$$

$$V_1/n_1 = V_2/n_2$$



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4. **Brownian motion** - Brownian motion, or pedesis, is the random motion of particles suspended in a medium. This pattern of motion typically consists of random fluctuations in a particle's position inside a fluid sub-domain, followed by a relocation to another

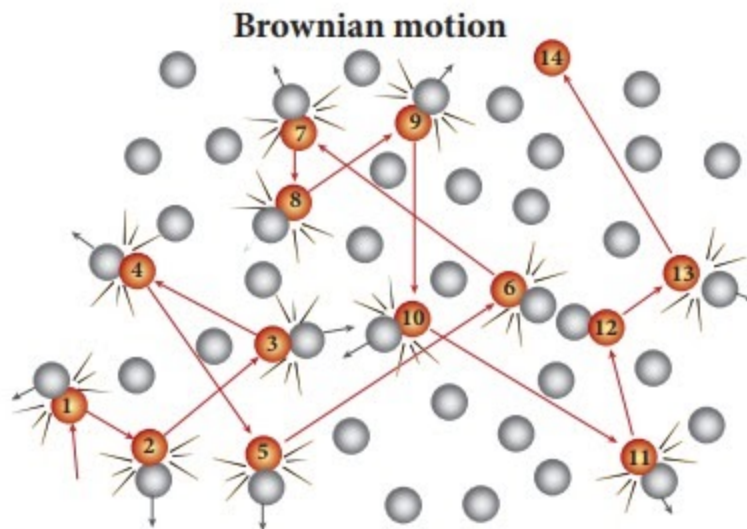
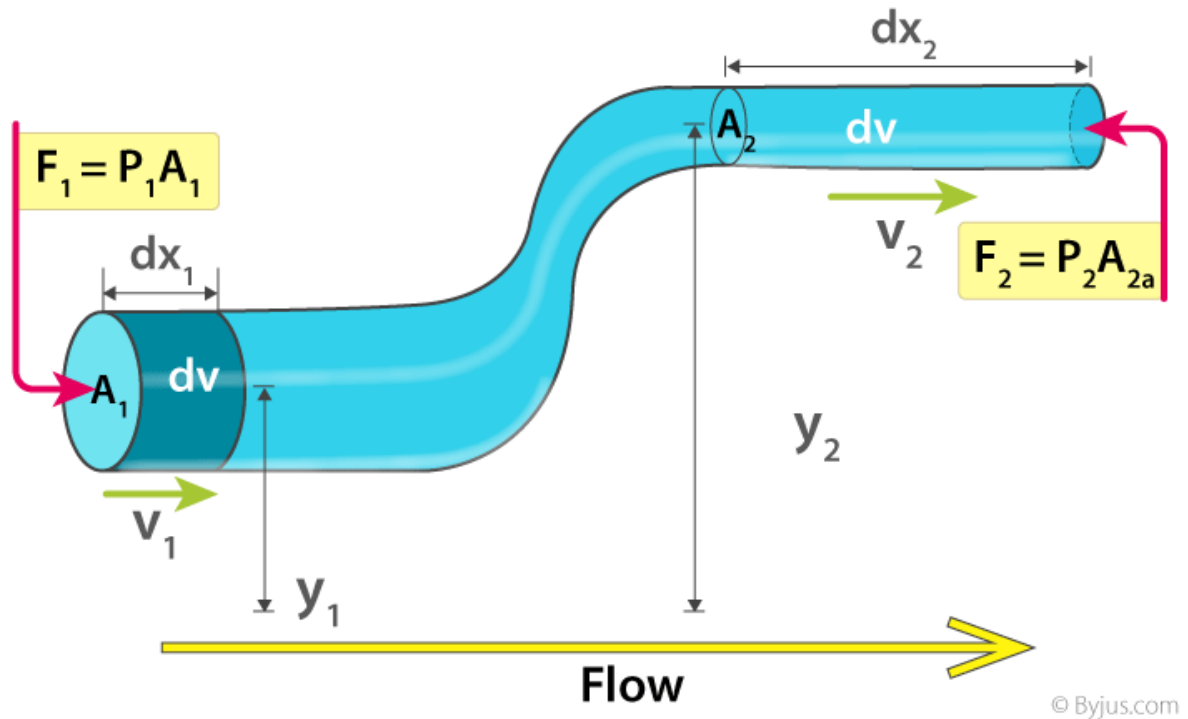


Figure 9.9 Particles in Brownian motion

sub-domain.

5. Bernoulli's principle - The total mechanical energy of the moving fluid comprising the gravitational potential energy of elevation, the energy associated with the fluid pressure and the kinetic energy of the fluid motion, remains constant.

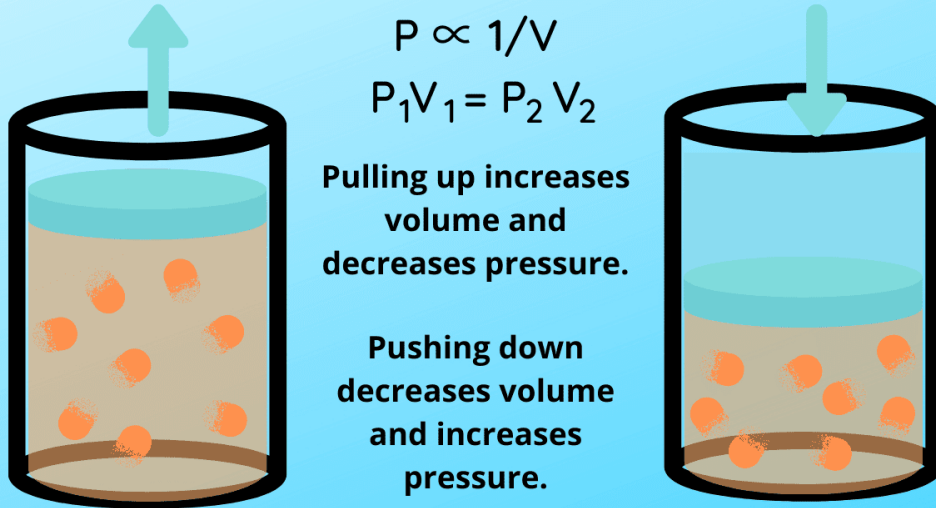
BERNOULLI'S EQUATION DERIVATION



6. Boyle's Law - It states that temperature remaining constant, the volume of a given mass of a gas varies inversely with the pressure of the gas. Thus, $PV = K$ (constant), where, P = Pressure and V = Volume.

Boyle's Law

The pressure of a gas increases as its volume decreases, assuming constant mass and temperature.



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7. Charles's Law - It states that pressure remains constant, the volume of a given mass of gas increases or decreases by $1/273$ part of its volume at 0-degree Celsius for each degree Celsius rise or fall of its temperature.

Charles's Law

Charles's law states that the volume of a gas is directly proportional to its absolute temperature, assuming the quantity of gas and pressure remain constant.

$$V_1 / T_1 = V_2 / T_2$$



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8. Coulomb's Law - It states that the force of attraction or repulsion between two charges is proportional to the amount of charge on both charges and inversely proportional to the square of the distance between them.

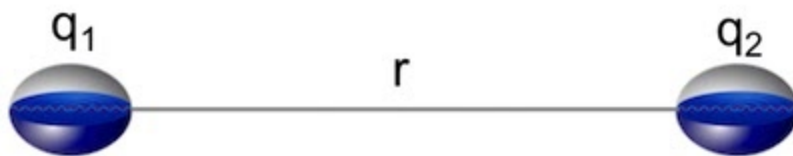
force

Coulomb's constant

particle charge

$$F = k_e \frac{q_1 q_2}{r^2}$$

distance



9. Heisenberg principle (uncertainty principle) - It is impossible to determine with accuracy both the position and the momentum of a particle such as an electron simultaneously.

10. Gay-Lussac's Law of combining volumes - Gases react together in volumes which bear simple whole number ratios to one another and also to the volumes of the products, if gaseous — all the volumes being measured under similar conditions of temperature and pressure.

Gay-Lussac's Law

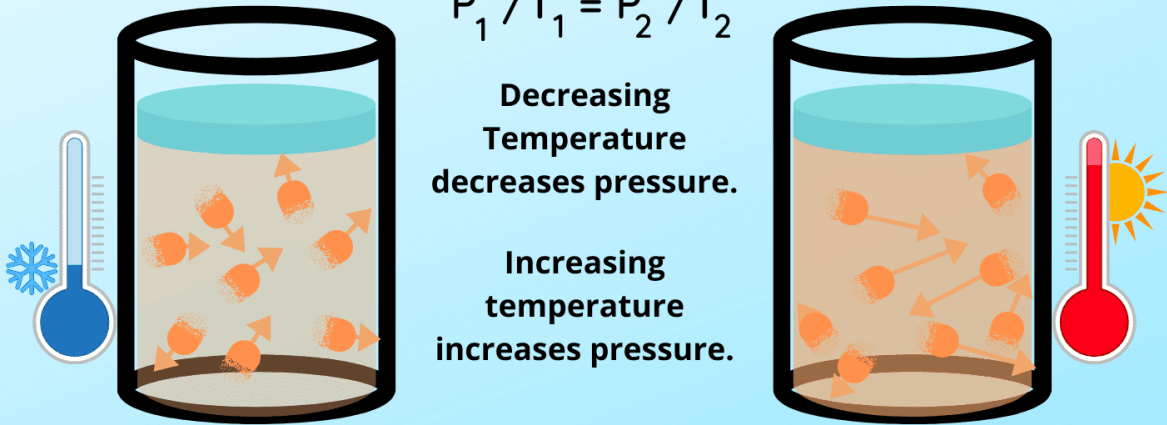
The pressure of a gas increases as its temperature increases, assuming constant mass and volume.

$$P \propto T$$

$$P_1 / T_1 = P_2 / T_2$$

Decreasing
Temperature
decreases pressure.

Increasing
temperature
increases pressure.



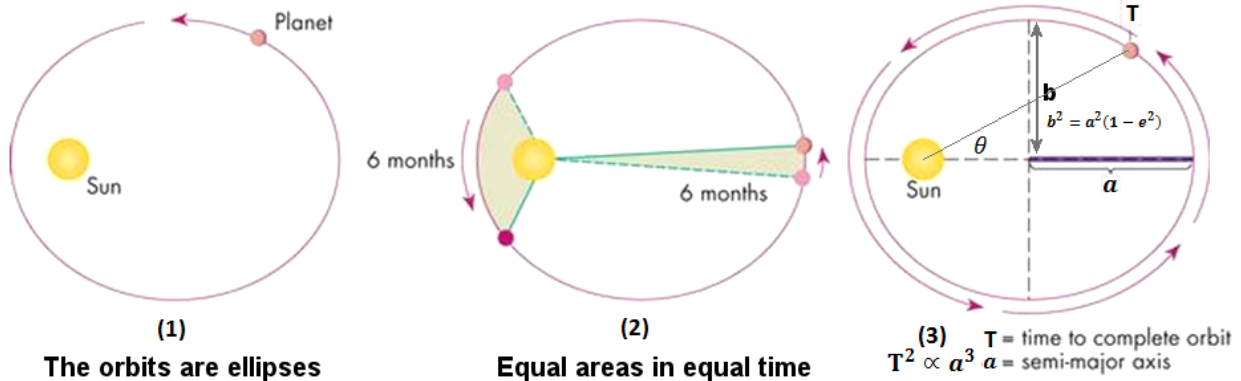
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11. **Graham's Law of Diffusion** - It states that the rates of diffusion of gases are inversely proportional to the square roots of their densities under similar conditions of temperature and pressure.

12. **Kepler's Law** - Each planet revolves around the Sun in an elliptical orbit with the Sun at one focus. The straight line joining the Sun and the planet sweeps out

equal areas in equal intervals. The squares of the orbital periods of planets are proportional to the cubes of their mean distance from the Sun.

Kepler's 3 Laws of Planetary Motion

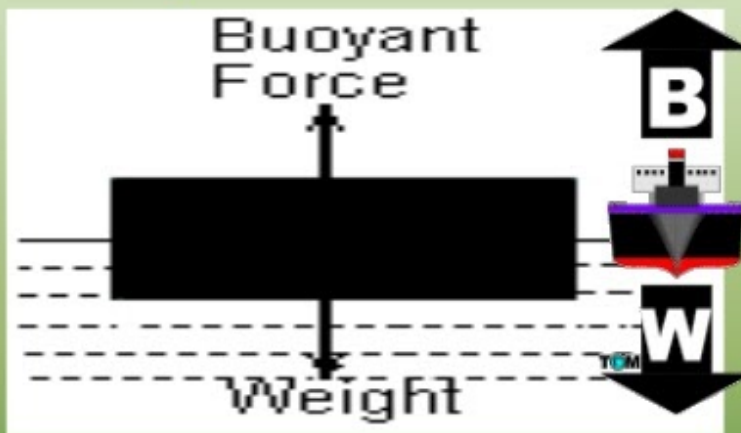


13. Law of Floatation - For a body to float, the following conditions must be fulfilled:

The weight of the body should be equal to the weight of the water displaced.

The centre of gravity of the body and that of the liquid displaced should be in the same straight line.

Buoyant Force and Floatation



Buoyant force = weight \Rightarrow the object floats and stationary

Buoyant force > weight \Rightarrow the object moves up

Buoyant force < weight \Rightarrow the object moves down

14. Law of conservation of energy - It states that energy can neither be created nor destroyed but it can be transformed from one form to another. Since energy

cannot be created or destroyed, the amount of energy present in the universe is always remain constant.

15. Newton's First Law of Motion - An object at rest tends to stay at rest, and an object in motion tends to stay in motion, with the same direction and speed in a

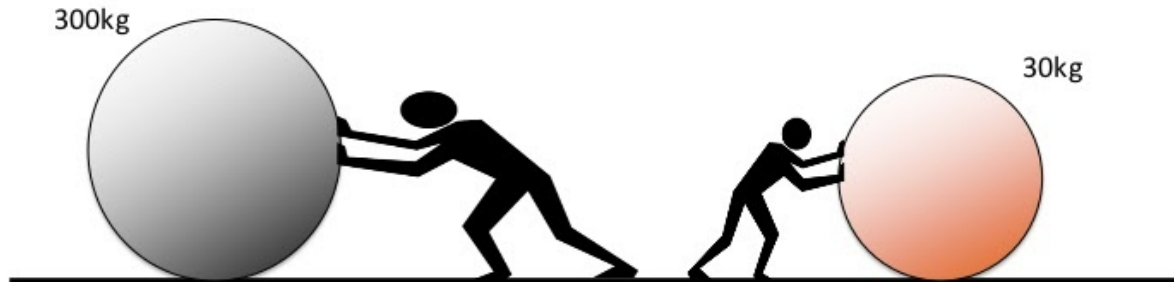
straight line unless acted upon by some external force.

Newton's First Law of Motion: **Inertia**

An **object** will not change its motion unless acted on by an unbalanced force.

- *if it is at rest, it will stay at rest*
- *if it is in motion, it will remain at the same velocity*

Objects with a **greater mass** have **more inertia**.
It takes **more force** to change their motion.



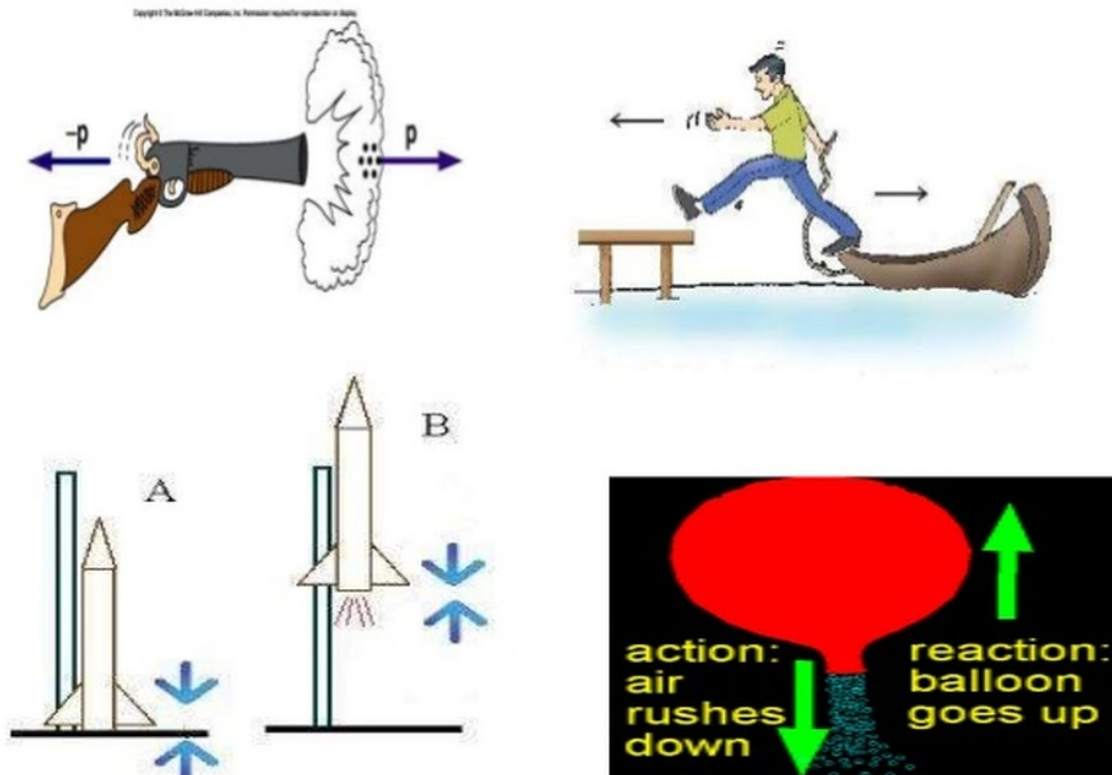
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16. Newton's Second Law of Motion - The rate of change of momentum of a body is directly proportional to the force applied and takes place in the direction in which the force acts.

17. Newton's Third Law of Motion - When one body exerts a force on the other body, the first body experiences a force which is equal in magnitude in the opposite direction of

the force which is exerted”.

Newton's Third Law of Motion



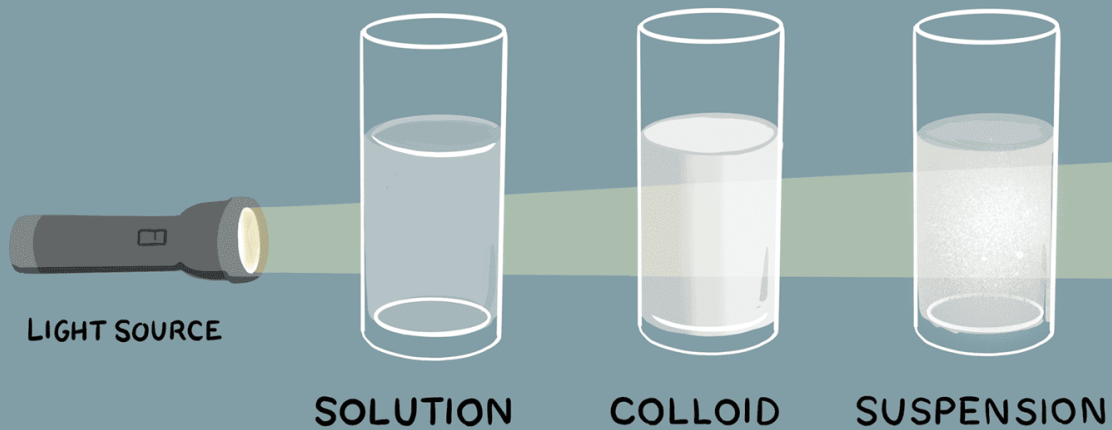
18. Newton's Law of Gravitation - All particles of matter mutually attract each other by a force directly proportional to the product of their masses and inversely proportional to the square of the distance between them.

19. Ohm's Law - It states that the current passing through a conductor between two points is directly proportional to the potential difference across the two points provided the physical state and temperature etc. of the conductor does not change.

20. Pauli exclusion principle - It explains that no two electrons in the same atom or molecule can have the same set of quantum numbers.

21. Raman effect - It is the change in wavelength that occurs when light is scattered by the atoms or molecules in a transparent medium.

22. Tyndall effect - The scattering of light by very small particles suspended in a gas or liquid.



LIGHT BEAM:

NOT VISIBLE

VISIBLE

VISIBLE

EXAMPLE:

WATER

MILK

FLOUR AND WATER

THE TYNDALL EFFECT

THE TYNDALL EFFECT IS THE SCATTERING OF LIGHT BY PARTICLES IN A COLLOID OR SUSPENSION.

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