Physics Review Sheet

From Simple Studies: https://simplestudies.edublogs.org & @simplestudiesinc on Instagram

Unit 1: Measurements

Measurements: The United States adopted the Metric System in which length is measured in meters (m), mass is measured in kilograms (kg), and time is measured in seconds (s).

Fundamental Quantities	SI Unit	Symbol
Length	meter	m
Mass	kilogram	kg
Time	second	s
Electric current	Ampere	A
Temperature	Kelvin	K
Amount of subtance	mol	mol
Luminous Intensity	candela	cd

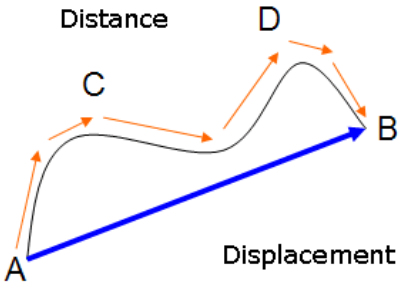
https://basic2tech.wordpress.com/2015/11/28/fundamental-and-derived-units-2/

Significant Digits:

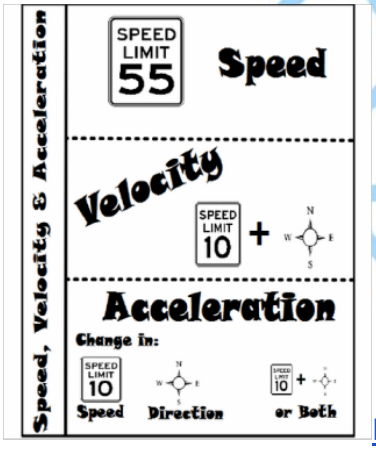
- All non-zero digits are considered to be significant
- Zeros that are used to hold place value hold no significance
- All digits in a scientific notation are significant
- Any zeros that are between non-zero digits are significant

Unit 2: Motion and Laws of Motion

- Distance: a scalar measurement that measures how far an object has moved
- Displacement: a vector quantity that measures the length and direction of the object's movement.



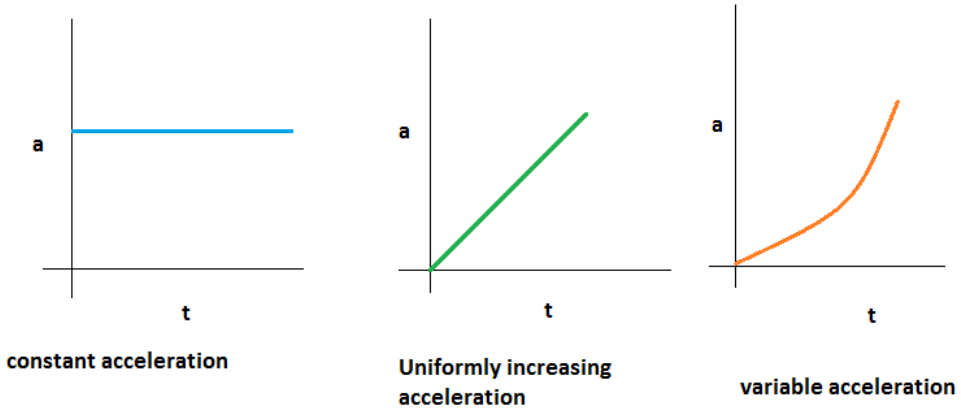
- https://socratic.org/questions/what-is-the-difference-between-distance-and-displacement



- http://arnwine.weebly.com/motion-speed-velocity-acceleration.html

- Speed: a scalar quantity that measures the rate in which an object moves
- Velocity: a vector quantity that measures the rate and direction of motion.
- Acceleration: a vector quantity that measures the rate in change of velocity. If the object's speed increases while moving, the acceleration is considered to be positive. If the

object’s speed decreases while moving, the acceleration is considered to be negative If the object's velocity is constant, there is no acceleration.



https://www.meritnation.com/ask-answer/question/draw-a-acceleration-time-graph-forconstant-acceleratio/motion/12836887

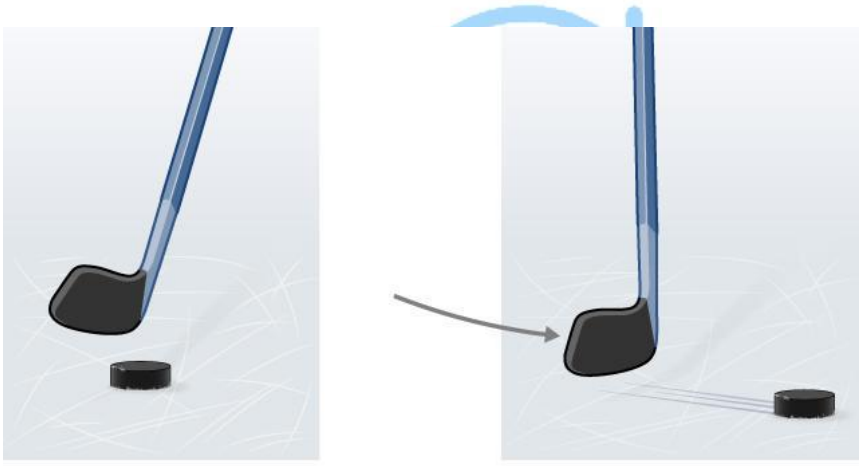
Unit 3: Forces

- Freefall: An object in free-fall does not encounter air resistance and accelerate downwards. The acceleration due to gravity will cause it to speed up until it hits the ground.

Newton's Laws of Motion

- 1st Law of Motion: An object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an outside force.

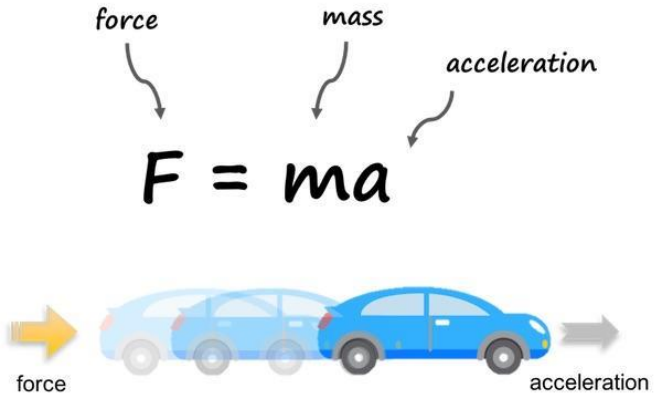
  - Inertia: is the resistance of an object as it changes in its state of motion. An object's inertia is dependent



- (a) (b)

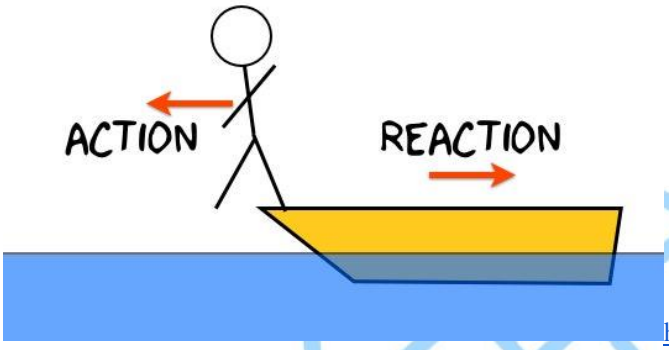
https://courses.lumenlearning.com/suny-osuniversityphysics/chapter/5-2-newtons-first-law/

- 2nd Law of Motion: The greater the mass of the object, the more force will be required to act upon it in order to accelerate the object.



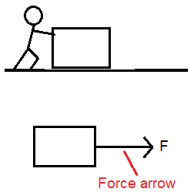
https://energywavetheory.com/equations/fma/

- 3rd Law of Motion: For every action force, there is an equal and opposite reaction force.



https://www.wired.com/2013/10/a-closer-look-at-newtons-third-law/

Force: A push or a pull that is acted upon on an object that causes objects to interact. Force is a vector quantity that has magnitude and direction. When forces are balanced, there is no acceleration occurring. Force is measured in newtons (N).

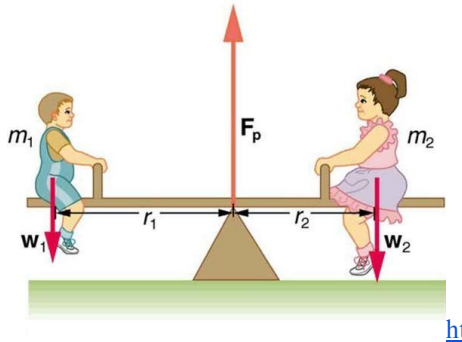


https://study.com/academy/lesson/using-force-arrows-in-physics-diagrams.html

Equilibrium: When the net force acting on an object is at zero, the object is at equilibrium and thus experiencing no acceleration.

Static equilibrium: The object is at rest.

Dynamic Equilibrium: The object is moving at a constant velocity.

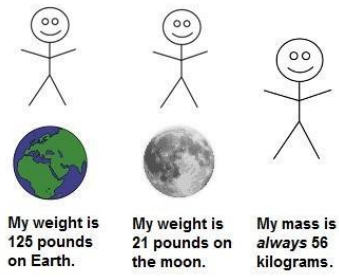


https://courses.lumenlearning.com/physics/chapter/9-2-the-second-condition-for-equilibrium/

Weight: The force of gravity that acts upon an object and is always directed toward the center of the earth. Weight is dependent on the planet that the object is on. Weight can vary depending on the planet it's on. Weight is measured in newtons (N).

Mass: A measure of inertia that remains the same universally. Mass is measured in kilograms (kg).

Normal Force: is a contact force between the object and the surface that it's interacting with. The normal force is perpendicular to the surface that it's in contact with.



https://tinycards.duolingo.com/decks/7rJgdtXe/weight-and-mass

Friction Force

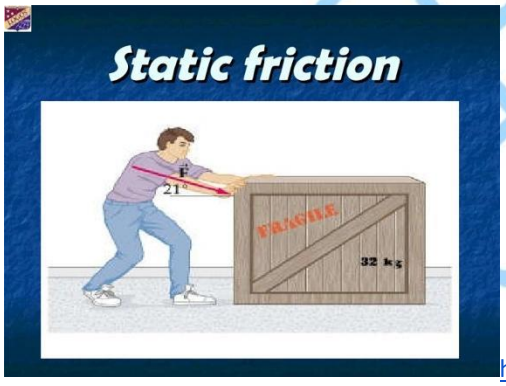
Principles of Friction:

- The force of friction opposes the relative motion between two surfaces that are interacting.
- Friction is dependent on the nature of the materials that is in contact with
- The force of friction is directly proportional to the force pressing the two surfaces together, also known as the normal force

Coefficient of Friction μ

- Mu is a factor that offers an indication of how much friction exists between 2 materials. The larger the factor, the larger the force of friction.

Static Friction

- The force of friction between objects that are not sliding relative to each other. Static friction increases as more force is applied to the object.
- 

https://www.slideshare.net/logosacademyeduec/friction-2675730

Kinetic Friction

- The force of friction between objects that are sliding against each other. Kinetic friction is dependent on Mu, the coefficient of friction, and the normal force.

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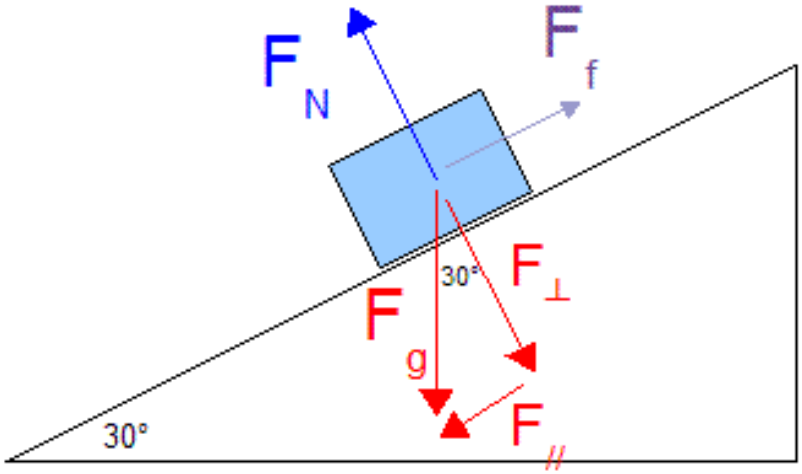
https://www.pinterest.com/pin/424182858640254038/

Inclined Planes

- For an object on an inclined plane or ramp, gravity is acting on the object and pulling it down as a result. The acceleration is dependent on the angle. At 90 degrees, free fall occurs.
- On a frictionless inclined plane, F(n) and F(g) are acting on the object. Normal force is perpendicular to the surface. Gravity points straight down towards the Earth and the object will move parallel to the ramp.



$F_{g\perp} = F_g \cos\theta$

$F_{g\parallel} = F_g \sin\theta$

http://www.studyphysics.ca/newnotes/20/unit01_kinematicsdynamics/chp06_vectors/lesson25.htm

Uniform Circular Motion

Centripetal force: causes an object to take a circular path. During uniform circular motion, the speed stays constant, but the direction changes. The change in direction is caused by centripetal force. Centripetal force always points towards the center. Centripetal force arises from both tension and gravity.

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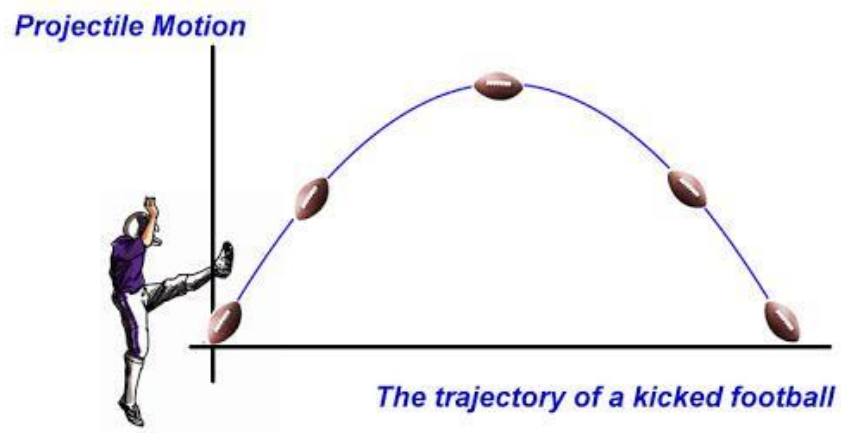
https://sites.google.com/site/rollercoasterscience/centripetal-centrifugal-force

Unit 4: 2D Projectile Motion

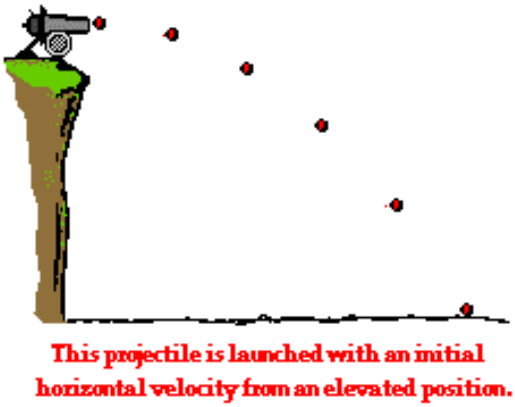
- Projectile motion occurs when an object is fired or shot into the air and then free fall occurs as a result of gravity. Gravity only acts in the y-axis and there are no forces in the x-axis. Therefore. There is no acceleration in the x-axis hence horizontal velocity remains constant while vertical velocity is accelerated.
- Trajectory: The path of a projectile through space.

- 

http://sdsu-physics.org/physics180/physics180A/units/unit1/chapter3.html

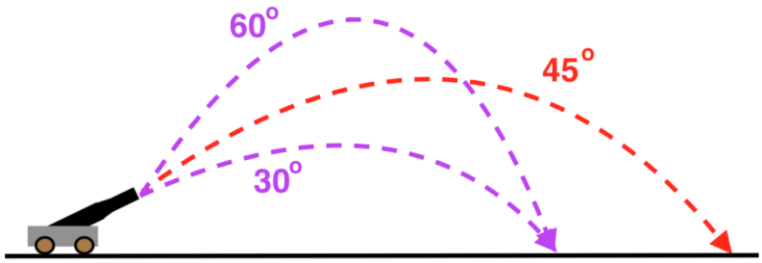
Horizontally Launched Projectiles

- The object doesn't accelerate horizontally after the initial launch, horizontal forces are no longer acting the object.
- The velocity of the object increases as the force of gravity causes the object to accelerate downwards.
- The parabolic shape of the trajectory is a result of both the constant horizontal velocity and the uniform vertical acceleration.

- 

https://www.physicsclassroom.com/class/vectors/Lesson-2/Horizontally-Launched-Projectiles-Problem-Solving

Angled Launches

- The initial velocity has both a vertical and horizontal component when the projectile is launched at an angle
- The velocity of the object is the same as it moves upwards and then downwards.
- The maximum height of the object is when the vertical velocity is at zero and.
- A projectile launched at 90 degrees will be able to reach its highest height possible. A projectile launched at 45 degrees will be able to reach its greatest range possible.
- 

https://www.khanacademy.org/science/ap-physics-1/ap-two-dimensional-motion/projectiles-launched-at-an-angle-ap/a/projectiles-launched-at-angles

Unit 5: Momentum

Momentum: Momentum describes a mass in motion and measures how much force is required to stop it. Momentum is a vector quantity that all moving objects possess. An object's momentum would change if its velocity changes (acceleration occurs). If an object undergoes an acceleration, it must be experiencing a force. A force will cause a change in momentum.

http://www.clipartoday.com/clipart/cartoons/cartoon/cartoon_264597.html

Impulse: Applying an external force to an object over a time interval results in a change in momentum. The impulse experienced by the object equals the change in momentum of the object.

Impulse Momentum Theorem

Impulse-Momentum Theorem

$$J = F_{net}\Delta t = \Delta p$$

J – impulse
Δp – change in momentum

https://tjregister.wordpress.com/2015/01/23/using-mythbusters-to-introduce-the-impulse-momentum-theorem/

Law of Conservation of Momentum

- The total momentum of the system is equal to the total momentum of the system after the collision. P before=P after

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

m_1 = mass of the 1st object

m_2 = mass of the 2nd object

u_1 = initial velocity of the 1st object

u_2 = initial velocity of the 2nd object

v_1 = final velocity of the 1st object

v_2 = final velocity of the 2nd object

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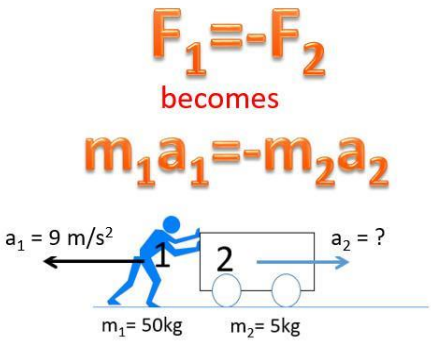
http://spmphysics.onlinetuition.com.my/2009/01/principle-of-conservation-of-momentum.html

Newton's Third Law and Momentum

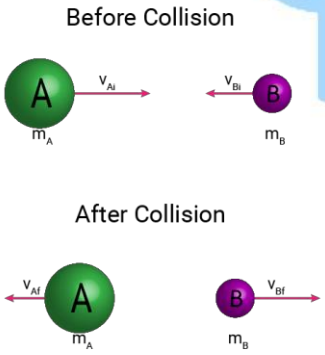
- According to Newton's 3rd law, when two objects interact, they exert equal and opposite forces on each other. The time that they are in contact are also equal. Therefore, the impulse they experience is equal. Since the impulse is equal, then the changes in momentum, must be equal.



- https://www.stickmanphysics.com/stickman-physics-home/forces/newtons-third-law-of-motion-action-reaction-pairs/

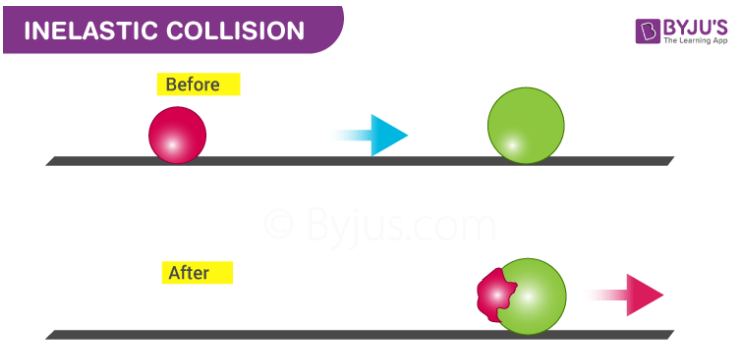
Collisions

- Occurs when objects collide and result in a change of motion as a result of internal forces between the objects. Collisions can be either elastic or inelastic.
- Elastic collisions: Two objects collide with each other and then separate after impact. The final velocities of the two objects may not be equal. Both momentum and kinetic energy are conserved.



- https://sciencenotes.org/elastic-collision-two-masses-can-shown-exercise/

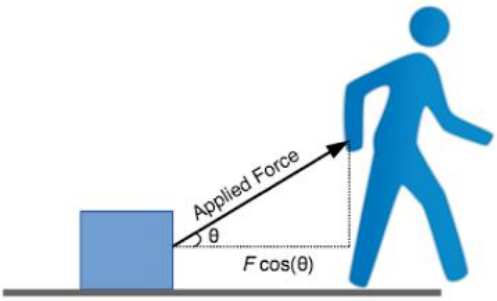
- Inelastic collisions: Two objects collide with each other, then move together after impact. The two objects become one larger object after the collision and have one velocity. Momentum is conserved and kinetic energy is not conserved.



- © Byjus.com https://byjus.com/physics/inelastic-collision/

Unit 6: Work, Power, and Energy

- Work: When a force acts on an object and causes a displacement of the object, it is said that work was done on the object. Work can be expressed by the following equation: Work=(Force)(Displacement). The unit for work is N x M, also known as Joules (J). Work is positive when the component of force and displacement are both in the same direction. Work is negative when the component of force and displacement are in opposite directions.



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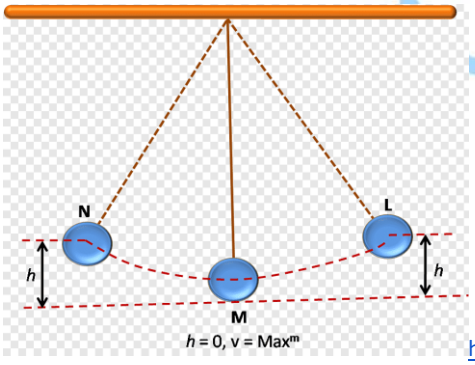
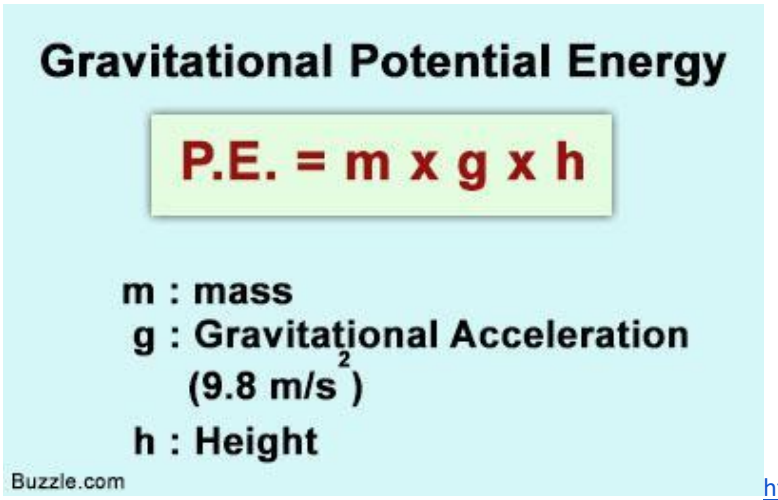
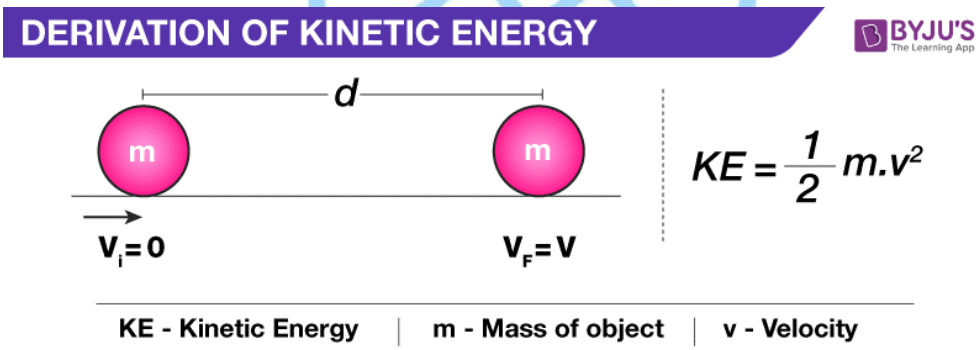
https://www.khanacademy.org/science/physics/work-and-energy/work-and-energy-tutorial/a/what-is-work

- Power: The rate at which work is done. Power can be expressed by the following equation: P= W/T. The unit for power is Joules/Second= Watt= Horsepower.
- 1 Horsepower=735.5 Watts
- Conservation of Energy: Energy can be neither created nor destroyed. Energy can only be transferred or transformed. When work is done on an object, energy is transferred or transformed.



- https://www.pngbarn.com/png-image-euoms
- Gravitational Potential Energy: When doing work against gravity, energy is stored in the gravitational field. Potential energy is an energy difference from a reference point, such as a surface below an object.

- 

http://patterson-science.weebly.com/gravitational-potential-energy-experiments.html
- As an object begins to fall, its potential energy decreases due to its loss in height. The lost potential energy becomes kinetic energy.
- Kinetic energy is the energy of motion. It describes the work needed to change the velocity of the object.
- 

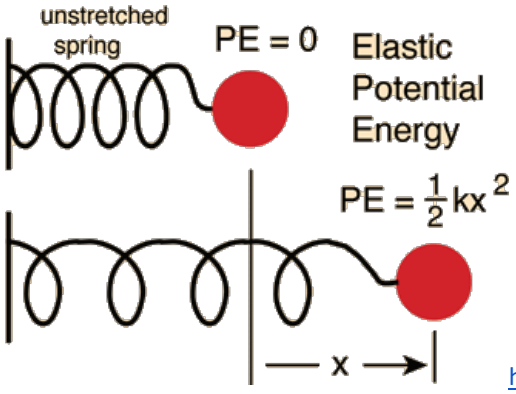
https://byjus.com/physics/derivation-of-kinetic-energy/
- Conservation of Mechanical Energy: The total energy in a system or object does not change. The energy in a system is only transformed into other forms.

$$PE_i + KE_i = PE_f + KE_f$$

https://gloveworldcoaster.weebly.com/mechanical-kinetic-and-potential-energy.html

Spring Potential Energy

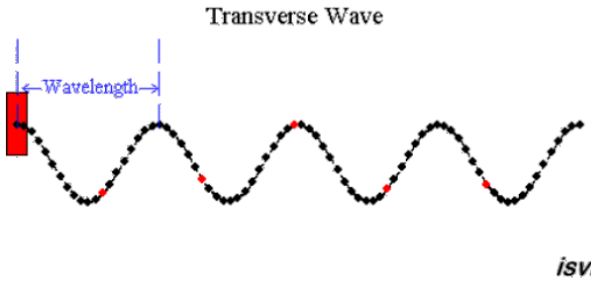
- Springs contain potential energy if it's stretched or compressed from its resting form. In order to stretch or compress a spring, work must be done.



- http://hyperphysics.phy-astr.gsu.edu/hbase/pespr.html

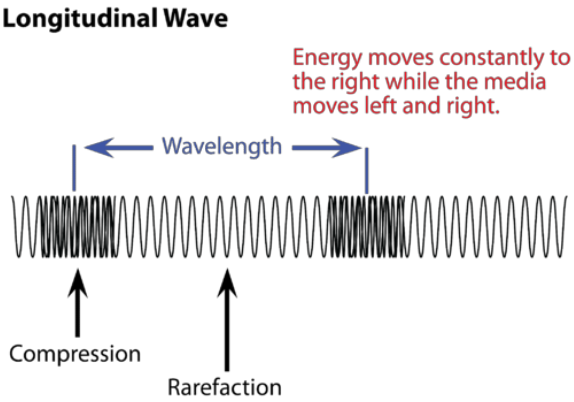
Waves

- A disturbance that moves through a medium causing a transfer of energy from one place to another. The different types of waves are transverse waves and longitudinal waves.
- Transverse waves: A wave where the particles in the medium move in a direction that is perpendicular to the direction that the wave moves in.



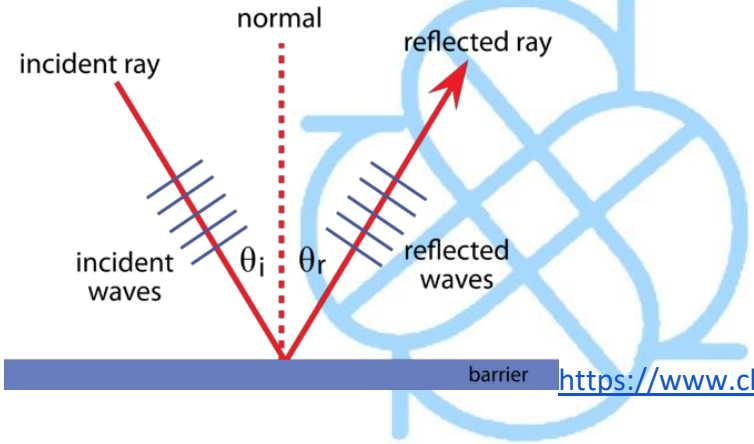
- http://resource.isvr.soton.ac.uk/spcg/tutorial/tutorial/Tutorial_files/Web-basics-nature.htm

- Longitudinal waves: A wave where the particles in the medium move in a parallel direction as the direction of the wave.



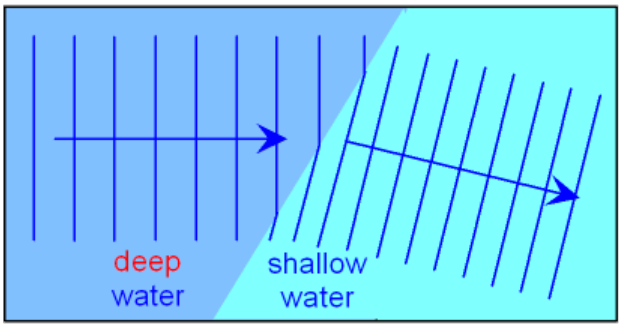
- https://www.ck12.org/c/physics/longitudinal-wave/lesson/Longitudinal-Waves-PHYS/

- Reflection of Waves: A wave "bounces back" to its original medium as a result of its change in direction of the wave front after striking a medium boundary.



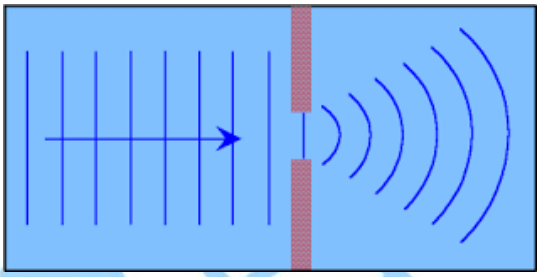
- https://www.ck12.org/physics/reflection-of-mechanical-waves/lesson/Reflection-of-Mechanical-Waves-PHYS/

- Refraction of Waves: A wave becomes distorted when passing from one medium to another. The speed and wavelength of refracted waves may alter. However, the frequency remains the same.

- 

https://socratic.org/questions/what-is-the-difference-between-light-refraction-and-diffraction

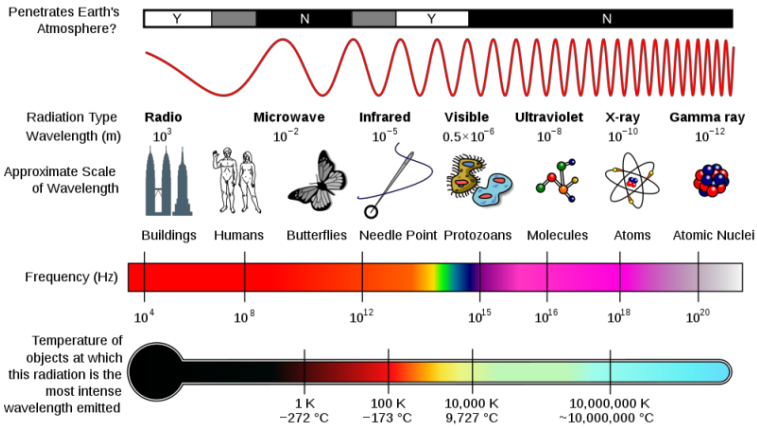
- Diffraction: Occurs as a result of the bending of waves around a barrier.

- 

https://sites.google.com/site/propertiesofwavessph3u/home/diffraction

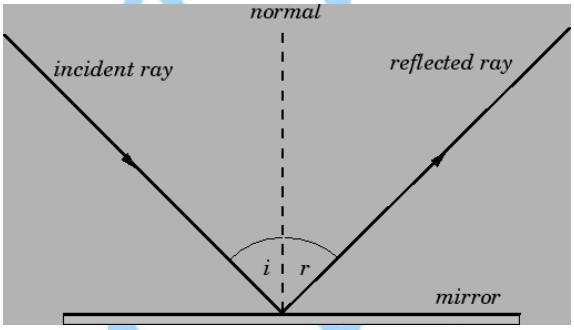
Unit 7: Light

- Light wave: An electromagnetic wave produced by vibrating electric charges. Light waves contain both electric and magnetic fields. This component allows electromagnetic waves to travel through vacuums and material mediums because electric and magnetic fields are both in both mediums.
- Electromagnetic Spectrum- The range of different types of electromagnetic radiation and its frequencies along with its wavelengths.

- 

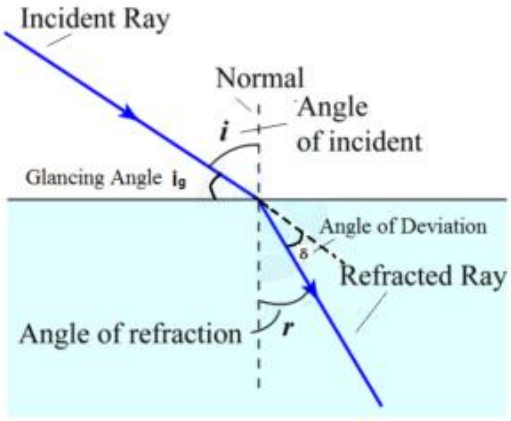
https://earthsky.org/space/what-is-the-electromagnetic-spectrum

- Law of Reflection: The angle of incidence is equivalent to the angle of reflection when a ray of light bounces off a surface.

- 

http://farside.ph.utexas.edu/teaching/302l/lectures/node127.html

- Refraction: Occurs when a wave enters a medium with a different speed causing the wave to bend.
- Index of Refraction: A value that is represented by the ratio of the speed of light in a vacuum to the speed of light in a different medium with a greater density. As the refractive index increases, the level of refraction when entering or leaving the material increases.



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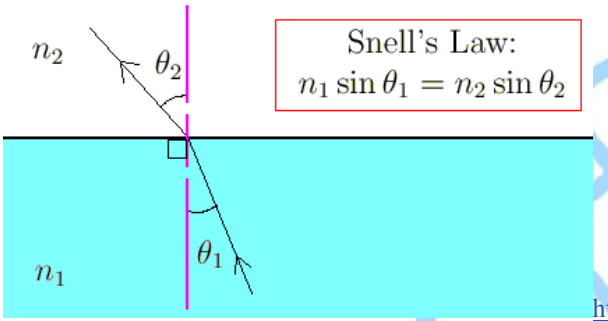
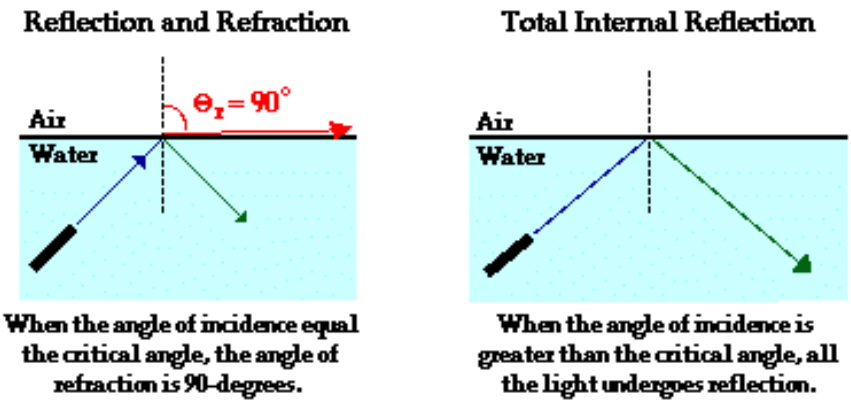
https://thefactfactor.com/facts/pure_science/physics/introduction-to-refraction-of-light/6973/

- Snell's Law: Implies that ratio of the sine of the angles of incidence and transmission is equivalent to the ratio of the refractive index of the between the two mediums.



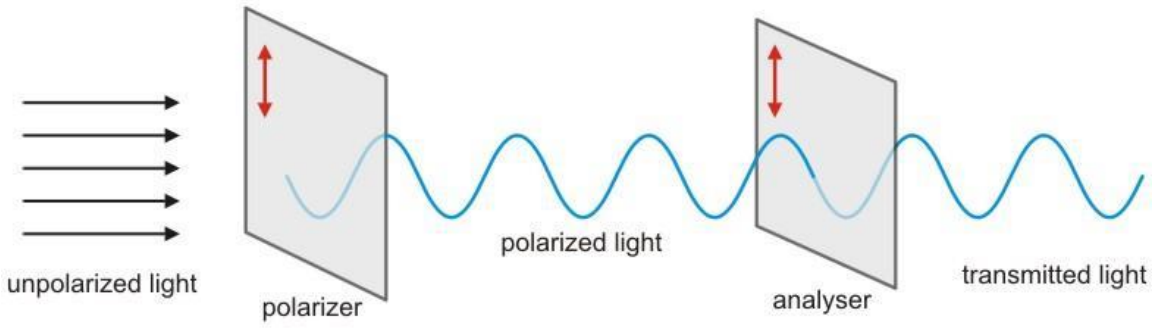
https://www.math.ubc.ca/~cass/courses/m309-01a/chu/Fundamentals/snell.htm

- Critical Angle of Incidence: The angle of incidence that results in an angle refraction of 90 degrees.



https://www.physicsclassroom.com/class/refrn/Lesson-3/The-Critical-Angle

- Total Internal Reflection: The reflection of the total amount of incident light at the interface between the two mediums. In order for this complete reflection to occur, the angle of incidence must be greater than the critical angle.
- Polarization: Occurs as a result of the wave's regular variation in position having a definite direction that is relative to the direction of propagation of the wave. During polarization, the electric fields are all vibrating in one direction.



https://www.saburchill.com/physics/chapters2/0041.html

Unit 8: Static Electricity and Circuits

- The Electron: negatively charged, -9.11x10^-31 kg
- The Proton: positively charged, -1.67x10^-27 kg

Facts to Know

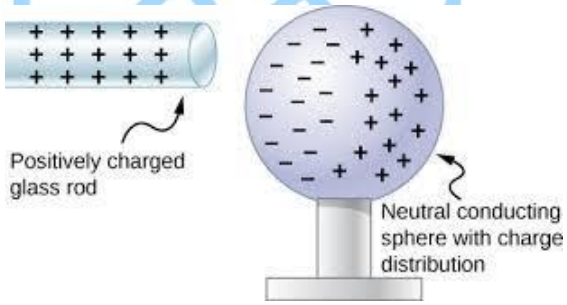
- Opposite charges attract
- Like charges repel
- Electrons and protons have equal and opposite charges

Law of Conservation of Charge

- The electric charge of an atom can neither be created or destroyed.

Charging by Induction

- A process used to charge an object without any physical contact between the other charged object. If a negatively charged rod is brought near the metallic sphere, negative charges will begin building up on the farther end of the sphere and positive charges will begin building up on the closer end of the sphere. This will continue to happen until equilibrium is reached in the metallic sphere.



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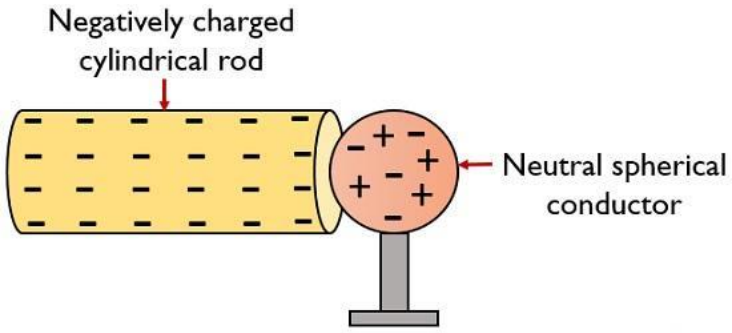
https://opentextbc.ca/universityphysicsv2openstax/chapter/conductors-insulators-and-charging-by-induction/

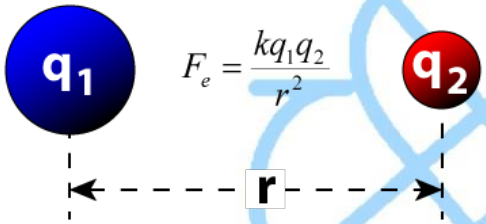
Charging by Conduction

- A process used to charge an object through physical contact. This direct contact causes a transfer of energy from the charged object to the neutral object. This results in a reduction of charge in the charged object.



- Circuit Globe https://circuitglobe.com/difference-between-conduction-and-induction.html

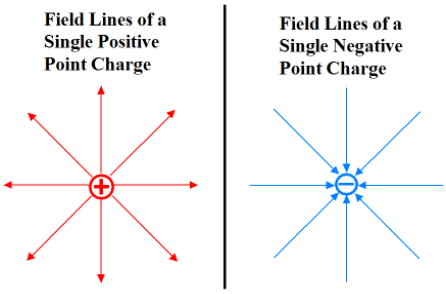
- Coulomb's Law: States that the electrostatic force between charged objects is proportional to the magnitude of charges between them and indirectly proportional to the square of distance between them.



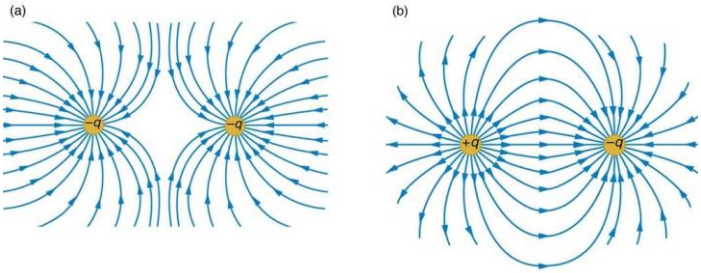
- https://www.quora.com/Why-do-we-multiply-the-magnitude-of-charges-in-Coulombs-Law

Electric Field Mapping

- Lines run out of a positive charge and run into a negative charge
- Line intersect charged objects at a right angle
- The number and density of the lines indicate the strength of the field
- Lines must never touch or cross themselves or other lines

- 

http://www.pstcc.edu/nbs/WebPhysics/Experim%2001.htm

- 

https://courses.lumenlearning.com/austincc-physics2/chapter/18-5-electric-field-lines-multiple-charges/

Electric Potential Energy: The energy stored in an electric field. The kinetic energy that is gained by a charged particle is equivalent to the potential energy lost in the electric field.

Electric Potential: The work that is required to move a particle from one point to another.

Electric Current: The time rate of flow of electric charge.

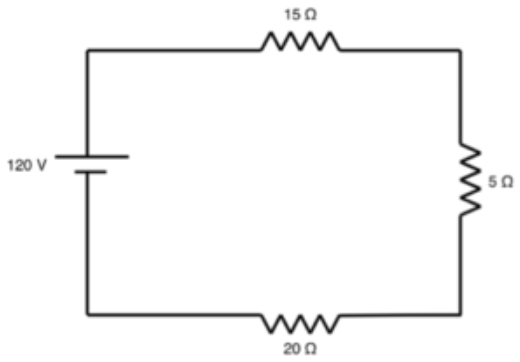
$$I(\text{amperes}) = \frac{Q(\text{coulombs})}{t(\text{seconds})}$$

https://digestiblenotes.com/physics/current_electricity/charge.php

Electrical Resistance

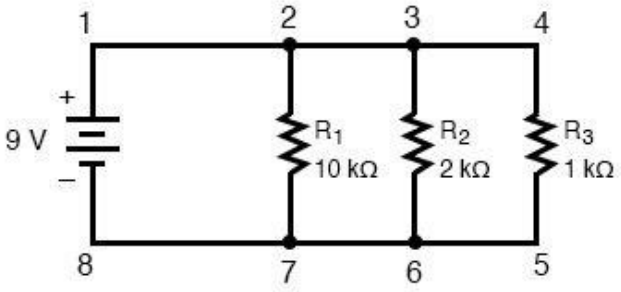
- A measure of an object's resistance to the flow of a steady electric current. Electrical resistance is measured in Ohms (∧).
- Resistance is affected by: length of wire, thickness of wire, type of material, and temperature

Series Circuit: A circuit with only one path for the electric current to flow through.



https://pressbooks.bccampus.ca/basicelectricity/chapter/fuses-and-circuit-breakers/

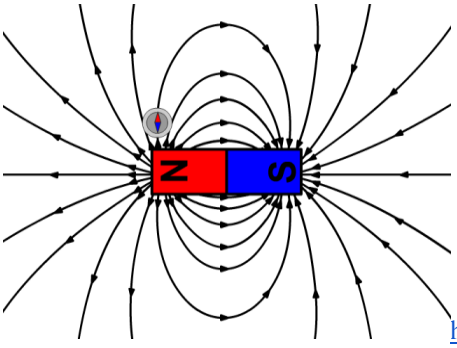
Parallel Circuit: A circuit with more than one path for the electric current to flow through.



https://www.allaboutcircuits.com/textbook/direct-current/chpt-5/simple-parallel-circuits/

Unit 9: Magnetism

Magnetic Fields: The field that makes a magnetic force move electric charges and magnetic dipoles. Magnetic fields are formed by moving charges.



https://www.stickmanphysics.com/stickman-physics-home/magnets-and-magnetism/magnetic-fields/

Magnetic Force: Magnetic forces allow charged particles to accelerate by changing their direction and can cause charged particles to move in circular paths.

Magnetic Flux: Provides a measurement for the number of magnetic field lines that pass-through a given surface. A change in the magnetic flux can create an electrical current.

Lenz's Law: The current flows in a direction that opposes the change that allowed for the flow of the current.

Unit 10: Modern Physics

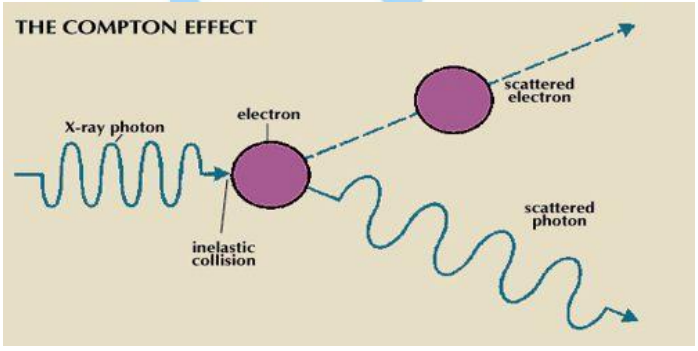
Quantum Theory: Evidence proposed by Max Planck that supported that light has both wave and particle properties. The quantum theory theorizes that electromagnetic energy is both emitted and absorbed in packets. The packets that are emitted and absorbed are known as quantum. The quantum of electromagnetic energy is known as a photon.

1. Electromagnetic radiation is emitted from a bundle of light waves also known as photons.
2. Photons contain energy in regard to its frequency.

Planck's Constant: The unit (h) in which a photon's energy can be related to its frequency.

The Compton Effect

- Arthur Compton carried out an experiment in which he was able to bounce an x-ray photon off an electric that created an electron with more kinetic energy that it previously had and an x-ray with less kinetic energy it previously had. A collision occurs allowing energy to be transferred to the electron. Both energy and momentum is conserved before and after the collision.



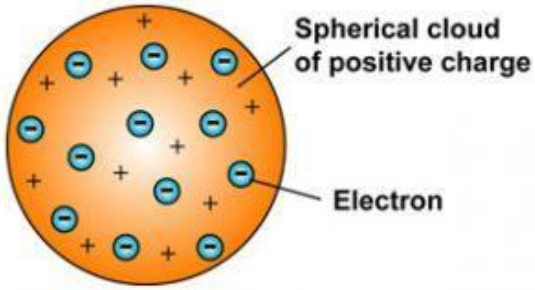
https://www.qsstudy.com/physics/compton-effect

The Matter-Wave Theory

- DeBroglie theorized that any particle of matter that has linear momentum is also considered a wave because if it has momentum, it has mass and velocity.

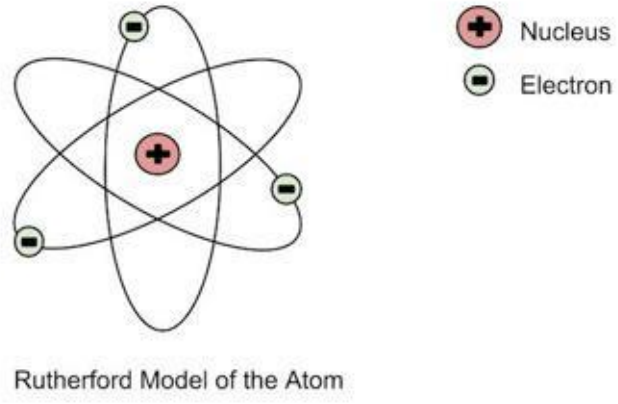
Models of the Atom

- Thomson's Model: Thomson's model proposes an atom that consists of a uniform distribution of positive and negative charges.



- https://socratic.org/questions/how-you-would-show-j-j-thomas-s-model-of-the-atom-using-small-beads-and-clay

- Rutherford's Model: Rutherford performed an experiment using gold foil, alpha particles, and a lead box with a small opening. Alpha particles that passed through the opening of the lead box were allowed to escape and follow the line to the gold foil. Most of the alpha particles were able to pass through the opening and only some of the alpha particles were deflected. Very few alpha particles bounced off the foil. Rutherford concluded that the atom is 99.99% empty space and the nucleus contains a positive charge and has the most mass in the atom.



Rutherford Model of the Atom

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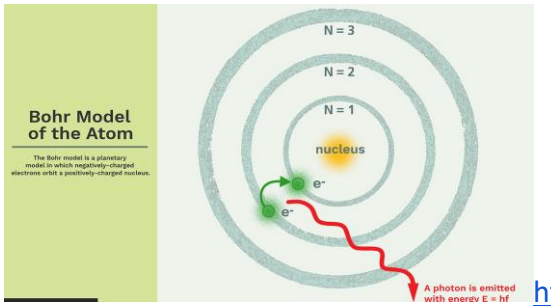
https://study.com/academy/lesson/rutherford-model-of-the-atom-definition-diagram-quiz.html

The Bohr Model

- Bohr's model depicted electrons travelling in circular orbits around the nucleus. These electrons can jump from one orbit to another when in an excited state. Bohr's model depicted Bohr's belief that all forms of energy are quantized. Kinetic energy is only gained or lost in fixed quantities.
- Each orbit in the atom had a specific amount of energy. The orbit closest to the nucleus has the least possible amount of energy for the electron.



- https://www.thoughtco.com/bohr-model-of-the-atom-603815

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