1. The energy of a photon is directly proportional to its frequency.
2. The principle of superposition states that when two or more waves overlap, the resulting wave is the sum of the individual waves.
3. The uncertainty principle suggests that the more precisely the position of some particle is determined, the less precisely its momentum can be known, and vice versa.
4. In a vacuum, all objects fall at the same rate regardless of their mass.
5. Electricity and magnetism are two aspects of a single electromagnetic force.
6. The period of a pendulum is independent of its mass and depends only on the length of the pendulum and the acceleration due to gravity.
7. Capacitors store electrical energy in an electric field, while inductors store energy in a magnetic field.
8. The Doppler effect causes the frequency of a wave to be higher in the direction of movement and lower in the direction away from movement.
9. Ferromagnetic materials can become permanently magnetized when exposed to a strong magnetic field.
10. The buoyant force on an object submerged in a fluid is equal to the weight of the fluid that the object displaces.
11. The efficiency of a heat engine is the ratio of the work it does to the heat input at the high temperature.
12. A photon's energy can be transferred to an electron in the photoelectric effect, ejecting the electron from its material.
13. The phase of matter can be changed not just by temperature but also by adjusting the pressure.
14. Lenses and mirrors form images through refraction and reflection, respectively, which can be real or virtual.
15. The resonance frequency of an object is the frequency at which it vibrates with the greatest amplitude.
16. The principle of conservation of momentum states that the total momentum of a closed system is constant if no external forces are acting on it.
17. Thermal conductivity is a property of a material that determines the rate at which heat passes through it.
18. Polarization of light can occur through reflection, refraction, or by passing the light through a polarizing filter, affecting its direction of oscillation.
19. Harmonic oscillators, like springs and pendulums, exhibit motion that repeats itself in a regular cycle known as harmonic motion.
20. The magnus effect explains how spinning objects traveling through a fluid, or the air, experience a force that acts perpendicular to the direction of motion and the spin axis.
21. Optical fibers transmit light signals over long distances with minimal loss, using total internal reflection.
22. The greenhouse effect is caused by atmospheric gases trapping heat radiated from Earth's surface, preventing it from escaping into space.
23. The Doppler radar uses the change in frequency of a radio wave reflected from a moving object to measure its speed.
24. A transformer changes the voltage of an alternating current by using two coils of wire, known as the primary and secondary coils, which are wound around a common core.
25. The Coriolis effect causes moving air and water to turn left in the Southern Hemisphere and right in the Northern Hemisphere due to Earth's rotation.
26. Geostationary satellites orbit the Earth at a speed matching the Earth's rotation, appearing stationary relative to the ground.
27. The principle of relativity states that the laws of physics are the same for all non-accelerating observers, regardless of their relative motion.
28. Photochromic lenses darken on exposure to UV light, due to a reversible chemical reaction in the lens material.
29. Bernoulli's principle explains why an airplane wing generates lift: the faster air moves over the wing, the lower the air pressure above it.
30. The Van Allen radiation belts are zones of energetic charged particles that surround the Earth, trapped by its magnetic field.
31. The Mpemba effect is the observation that, in some circumstances, warmer water can freeze faster than colder water.
32. Fiber optics technology uses the principle of total internal reflection to transmit light over long distances with minimal loss.
33. A heat pump transfers thermal energy from a cooler space to a warmer space, contrary to the natural direction of heat flow.
34. Piezoelectric materials generate an electric charge in response to applied mechanical stress.
35. The Michelson-Morley experiment provided evidence for the constancy of the speed of light and the absence of the "aether", leading to the development of special relativity.
36. Interference patterns from light waves occur when two or more waves overlap, creating a pattern of alternating bright and dark bands due to constructive and destructive interference.
37. An object's center of mass is the point where it can be balanced without rotation, depending on the distribution of its mass.
38. Critical angle is the angle of incidence above which total internal reflection occurs for light passing from a medium with a higher refractive index to one with a lower refractive index.
39. Gyroscopic effect explains why a spinning top does not fall over; the angular momentum of the spinning object keeps it upright.
40. The Venturi effect describes how fluid speed increases and pressure decreases in areas where the flow passage narrows.
41. Superposition in quantum mechanics allows particles such as electrons to exist in multiple states simultaneously until measured.
42. The photoelectric effect demonstrates that light can be thought of as particles (photons) when it causes electrons to be ejected from a metal surface.
43. Liquid crystals, found in LCD screens, change their optical properties in response to electric fields, allowing them to display images.
44. The Stefan-Boltzmann law states that the total energy radiated per unit surface area of a black body is proportional to the fourth power of its temperature.
45. Rayleigh scattering is why the sky is blue; molecules in the atmosphere scatter sunlight, and blue light is scattered more than other colors due to its shorter wavelength.
46. The principle of conservation of energy states that energy cannot be created or destroyed, only transformed from one form to another.
47. Polarized sunglasses reduce glare by blocking light waves oriented in certain directions.
48. The triple point of a substance is the unique temperature and pressure at which its solid, liquid, and gas phases coexist in equilibrium.
49. The Heisenberg Uncertainty Principle states that it is impossible to simultaneously know the exact position and momentum of a particle.
50. Laminar flow is characterized by smooth, constant fluid motion, whereas turbulent flow is chaotic and irregular.
51. The Raman effect is the inelastic scattering of photons by molecules, which results in a change in their energy and is used to study vibrational, rotational, and other low-frequency modes in a system.
52. Ferrofluids are liquids that become strongly magnetized in the presence of a magnetic field due to the suspension of magnetic nanoparticles.
53. A Foucault pendulum demonstrates the rotation of the Earth through its apparent change in swinging direction over time.
54. Supercooling occurs when a liquid is cooled below its freezing point without becoming a solid.
55. The Hall effect is the generation of a voltage across an electrical conductor, transverse to an electric current in the conductor and a magnetic field perpendicular to the current.
56. The Gibbs free energy change of a process predicts whether a reaction will proceed spontaneously at constant temperature and pressure.
57. Optical tweezers use a highly focused laser beam to manipulate microscopic particles, including cells, without physical contact.
58. The Zeeman effect is the splitting of a spectral line into several components in the presence of a static magnetic field.
59. Quantum dots are semiconductor particles a few nanometers in size, having optical and electronic properties that differ from larger particles due to quantum mechanics.
60. The Seebeck effect describes the conversion of temperature differences directly into electricity at the junction of different types of metal.
61. The Doppler Effect not only affects sound waves but also light waves, which is why stars moving away from us appear redder (redshift).
62. A soap bubble shows colors due to thin-film interference, where light waves reflected from the outer and inner surfaces of the bubble film interfere with each other.
63. Bioluminescence in deep-sea creatures is a form of chemiluminescence where chemical reactions within the organism produce light.
64. The principle of Archimedes explains not only why ships float but also how submarines can dive and surface by changing their buoyancy.
65. Cryogenics involves the study of the behavior of materials at very low temperatures, often leading to unusual physical properties like superconductivity.
66. Thermoelectric materials generate electricity directly from temperature differences through the Seebeck effect, which can be used for power generation or cooling.
67. Non-Newtonian fluids change their viscosity in response to applied stress, behaving as a liquid under low stress and as a solid under high stress.
68. The greenhouse effect, while necessary for life on Earth by trapping heat in the atmosphere, is exacerbated by increased levels of greenhouse gases, leading to global warming.
69. The Magnus effect explains how spinning balls or cylinders curve away from their principal flight path due to differences in air pressure.
70. Fiber optic cables work by bouncing light off the walls of a very thin glass or plastic tube, allowing for high-speed data transmission over long distances.
71. The Venturi effect causes fluid pressure to decrease as the fluid speeds up when flowing through a narrowed section of a tube.
72. Phase diagrams illustrate the conditions of temperature and pressure under which different phases (solid, liquid, gas) of a substance exist.
73. Superposition principle in physics states that, for all linear systems, the net response at a given place and time caused by two or more stimuli is the sum of the responses that would have been caused by each stimulus individually.
74. Birefringence is an optical property of a material having a refractive index that depends on the polarization and propagation direction of light.
75. A Schrödinger's cat thought experiment illustrates the concept of superposition in quantum mechanics, suggesting a cat in a box could be simultaneously alive and dead until observed.
76. The Leidenfrost effect occurs when a liquid, in near contact with a mass significantly hotter than the liquid's boiling point, produces an insulating vapor layer keeping that liquid from boiling rapidly.
77. Chromatic aberration in lenses is a type of distortion in which there is a failure of a lens to focus all colors to the same convergence point, occurring because lenses have a different refractive index for different wavelengths of light.
78. The piezoelectric effect causes certain materials to generate an electric charge in response to applied mechanical stress.
79. Sonoluminescence is the phenomenon by which sound waves in a liquid create small pockets of gas that collapse, emitting short bursts of light.
80. The Mpemba effect is the counterintuitive observation that hot water can sometimes freeze faster than cold water under certain conditions.
81. Fresnel lenses use multiple concentric rings to focus light, allowing for a much thinner lens that can be used in lighthouses and projectors.
82. The Coriolis effect influences the flow of air and water across the Earth, causing the direction of winds and ocean currents to curve relative to the Earth's rotation.
83. Quantum tunneling allows particles like electrons to pass through a barrier that they classically shouldn't be able to, a principle used in the operation of tunnel diodes.
84. The Kelvin-Planck statement of the second law of thermodynamics states that it is impossible to devise a cyclically operating device whose sole effect is the absorption of heat from a reservoir and the complete conversion of that heat into work.
85. Metamaterials are engineered to have properties not found in naturally occurring materials, such as negative refractive index, enabling applications like cloaking devices.
86. The gyroscopic effect stabilizes spinning objects, making it difficult to change the orientation of their rotation axis, a principle used in bicycles and spacecraft navigation.
87. Brewster's angle is the angle of incidence at which light with a particular polarization is perfectly transmitted through a transparent dielectric surface, with no reflection.
88. The Stefan-Boltzmann law relates the energy radiated by a black body to the fourth power of its temperature, explaining why objects at higher temperatures emit more radiation.
89. Critical damping occurs in an oscillating system when the damping is strong enough to return the system to equilibrium in the shortest time without oscillating.
90. The photoelectric effect demonstrates that light can eject electrons from a metal surface, suggesting that light behaves as both a wave and a particle.
91. Optical fibers transmit information using pulses of light, taking advantage of total internal reflection to guide light along the fiber's length without significant loss.
92. The Bernoulli principle explains why aircraft wings are shaped to create lift: faster-moving air above the wing reduces pressure, lifting the wing upward.
93. Superconductors are materials that can conduct electricity with zero resistance below a certain temperature, leading to applications like magnetic levitation.
94. The Doppler radar measures the speed of objects, such as vehicles or weather fronts, by observing the change in frequency of the returned radar signal due to the Doppler effect.
95. Thermal expansion is the tendency of matter to change its shape, area, and volume in response to a change in temperature, explaining why bridges have expansion joints.
96. The concept of wave-particle duality in quantum mechanics suggests that all particles exhibit both wave-like and particle-like properties, depending on the experimental setup.
97. Geiger counters detect ionizing radiation by measuring the ionization of a gas within a tube, indicating the presence of radioactive particles.
98. The principle of a heat engine involves converting thermal energy into mechanical work, as seen in car engines and power plants, governed by the laws of thermodynamics.
99. In ferromagnetic materials, domains align to strengthen a magnetic field when magnetized, a principle used in the design of permanent magnets and electronic devices.
100. Electromagnetic induction is the process by which a changing magnetic field within a coil generates an electric current through the coil, fundamental to the operation of generators and transformers.