INTRODUCTION TO PHYSICS

1.

Physics: Foundation of Science

Unit Introduction

The study of the structure of matter & relationships between the most fundamental building blocks of an observable universe is the domain of the scientific discipline known as **physics**. In its most general definition, physics, which derives its name from the Greek word physikos, is the study of every aspect of nature, both on the macroscopic and the submicroscopic scales (Farmelo, 1992). It examines how things behave when subjected to certain forces' actions and nature & genesis of electromagnetic, nuclear & of gravitational force fields. Its scope of study involves objects' behavior when subjected to specific forces' actions. Establishing several overarching principles that can unify and explain these seemingly unrelated events will ultimately serve the project's primary goal (Hagelin, 1989).

Did you know?

Physics has been responsible for an estimated 45% of the world's economic growth since the 19th century, contributing to advances in medicine, energy, and communications technology.

The most fundamental aspect of the physical sciences is physics. Until recently, the terms natural philosophy and physics were used interchangeably to refer to the branch of research whose primary objective is the identification and elucidation of the natural world's fundamental laws. Because other branches of the physical sciences, such as astronomy, chemistry, geology, and engineering, cover some of the same ground, the term *"physics"* refers to the subfield of the physical sciences that encompasses the rest (Friedman, 2014). However, physics plays an essential part in all of the natural sciences, & these subjects have subfields in which physical principles & measurements are emphasized. These subfields have names like astrophysics, geophysics, biophysics, and even psychophysics, and they are found in all of the natural sciences. Physics is the study of motion, matter, & energy at its most fundamental level. Mathematics is frequently used as a language for its laws because of its efficiency and precision in expressing concepts (Majer, 2001).

Theory, which is the development of a comprehensive conceptual framework, and experiment, which is the observation of events under conditions that are as precisely controlled as possible, both play essential and complementary roles in the evolution of physics. The experiment is defined as the observation of phenomena under conditions that are controlled as precisely as feasible (Von Keudell et al., 2017). Experiments on matter lead to the collection of measurements, which are then evaluated in light of the results expected by theory. A theory is considered to incorporate a law of physics if it can make accurate predictions regarding the outcomes of experiments to which it can be applied. However, a law is always subject to being modified, replaced, or restricted to more limited realm if subsequent experiment deems it essential. This is because laws are meant to be flexible and adaptable to changing circumstances (Zeilinger, 1999). Find a cohesive set of laws that govern motion, matter, and energy at the smallest (microscopic) subatomic distances, the largest (extragalactic) distances, and the human (macroscopic) scale of daily life). This is the ultimate goal of physics. This lofty objective has been accomplished to a very significant degree. A relatively limited set of fundamental physical principles appears to be able to explain all known events, despite the fact that a fully unified theory of physical phenomena has not yet been developed (and it may never be). This is very promising development (Bunge, 2013). Classical physics is a branch of physics developed until roughly the turn of the 20th century. It is capable of explaining most phenomena, including electricity, light, heat, magnetism, & sound as well as motions of macroscopic objects that move slowly relative to speed of light. These principles have been modified since they pertain to faster speeds, very big objects, and the minuscule elementary constituents of matter, such as electrons, protons, and neutrons. The recent developments in relativity and quantum mechanics are responsible for these modifications (Carnap, 1966).

Learning Objectives

At the end of this chapter, reader will be able to understand

1. The methodology of physics and how it contributes to scientific research.
2. The relations between physics and other disciplines, including the influence of physics on related fields and vice versa.
3. The role of physicists in society and the importance of physics to humanity.
4. The scope of physics, including its various subfields such as mechanics, gravitation, and thermodynamics.
5. The laws of thermodynamics and their significance in physics.

Key Terms

1. Interdisciplinary
2. Thermodynamics
3. Mechanics
4. Gravitation
5. Physicist
6. Laws of Thermodynamics.

1. Methodology of Physics

Without relying on a single approach, physics has changed and is still changing. Refined measurements can show unexpected behavior because science is fundamentally an experimental field. On the other hand, as is true for all of science, each of the following factors is involved: Argument via symmetry or analogy, aesthetic judgment, pure accident, instinct, mathematical expansion of current ideas into new theoretical domains, critical reexamination of seemingly obvious but unproven assumptions. For instance, German physicist Max Planck's quantum hypothesis was founded on an observation that blackbody radiation properties—radiation released by a heated body which absorbs every incident radiant energy—differed from those anticipated by classical electromagnetism (Hestenes, 1997).

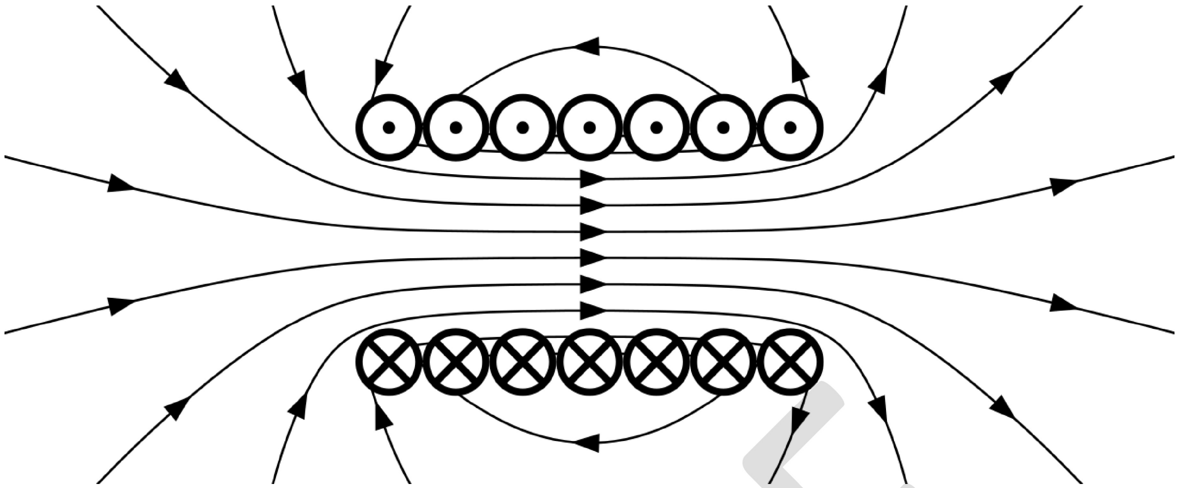

Figure **Error! No text of specified style in document.**.1. Depiction of classical electromagnetism (Source: Geek3, Creative Commons License)

In creating relativistic extension of quantum theory of electron, English physicist P.A.M. Dirac predicted positron existence. German physicist Wolfgang Pauli proposed the elusive neutrino as a solution to breaking the conservation laws during beta decay. The neutrino has neither mass nor charge. Maxwell proposed the electromagnetic theory of light by speculating that since it is known that changing magnetic fields can result in electric fields, it is possible that changing electric fields can result in magnetic fields as well. Albert Einstein's special theory of relativity was grounded on a careful reexamination of concept of simultaneity, unlike his general theory of relativity, which is based on the equivalence of inertial and gravitational mass (Morse & Feshbach, 1954).

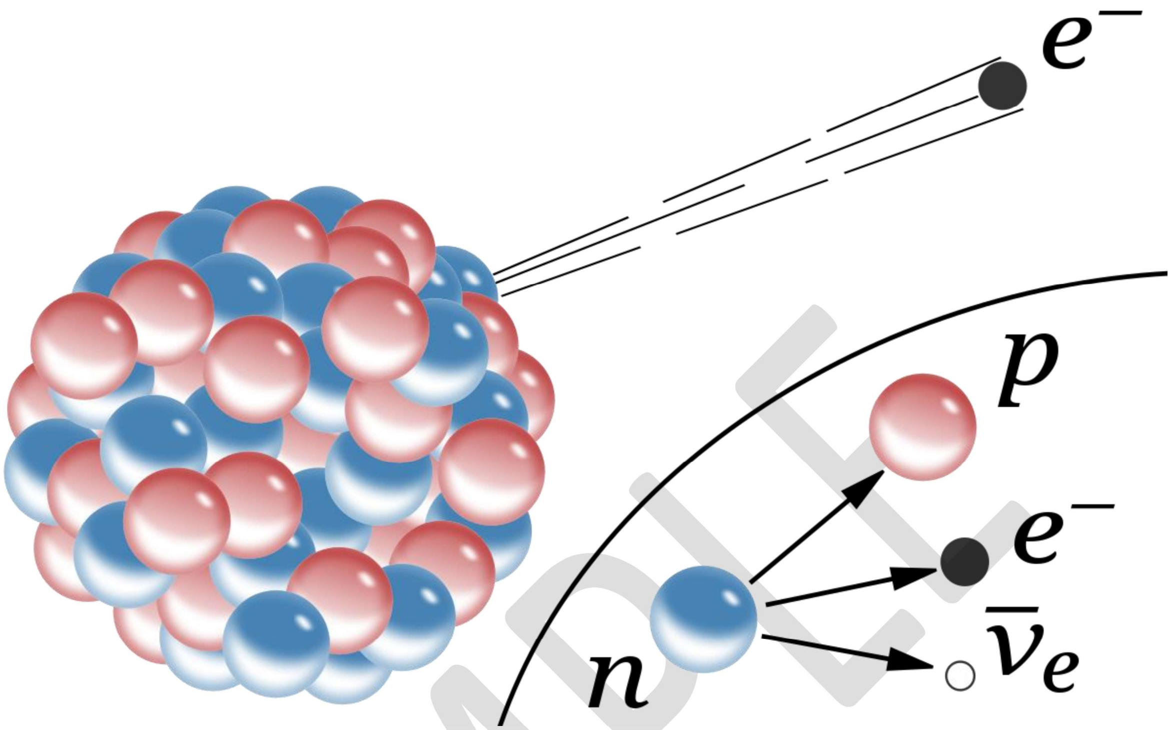

Figure **Error! No text of specified style in document.**.2. Illustration of beta decay (Source: Beta Minus Decay, Creative Commons Liense)

The physicist invariably attempts to make unsolved issues more tractable by building a sequence of idealized models, with each subsequent model being a more realistic portrayal of the actual physical condition. However, strategies may differ from problem to problem. As a result, in the theory of gases, molecules are initially thought of as vanishingly small, structureless particles of the same size as pool cues. Then, this ideal image is incrementally enhanced (Margenau, 1935).

Danish physicist Niels Bohr developed correspondence principle of quantum theory. It is useful guiding principle for extending theoretical interpretations. It states that when a sound theory is expanded to cover a wider range of situations, the new theory's predictions must concur with old one in areas where both of them are applicable. For instance, whenever wave effects proportionate to wavelength of light are minimal due to that wavelength's smallness, more thorough theory of physical optics must produce same outcome as the more limited theory of ray optics. Similarly, since Planck's constant is thought to be negligibly small, quantum mechanics must have same outcomes as classical mechanics. Relativistic mechanics must agree with Newtonian classical mechanics for speeds slower than speed of light, like those of baseballs in play. Here are some approaches experimentalists and theoretical physicists use to solve their difficulties (Seroglou & Koumaras, 2001).

The discovery of new kinds of unstable particles formed in atmosphere by primary radiation, mostly made up of high-energy protons arriving from space marked the beginning of the experimental study of elementary particles in the contemporary era. New particles were discovered using Geiger counters & identified using prints they left on photographic plates and in cloud chambers, two types of devices. Particle physics, formerly high-energy nuclear physics, emerged after World War II. Modern high-energy particle accelerators can be several kilometers long, cost hundreds of millions of dollars, and have an unmatched ability to accelerate particles to extremely high energies (trillions of electron volts) (Garcia, 2000).

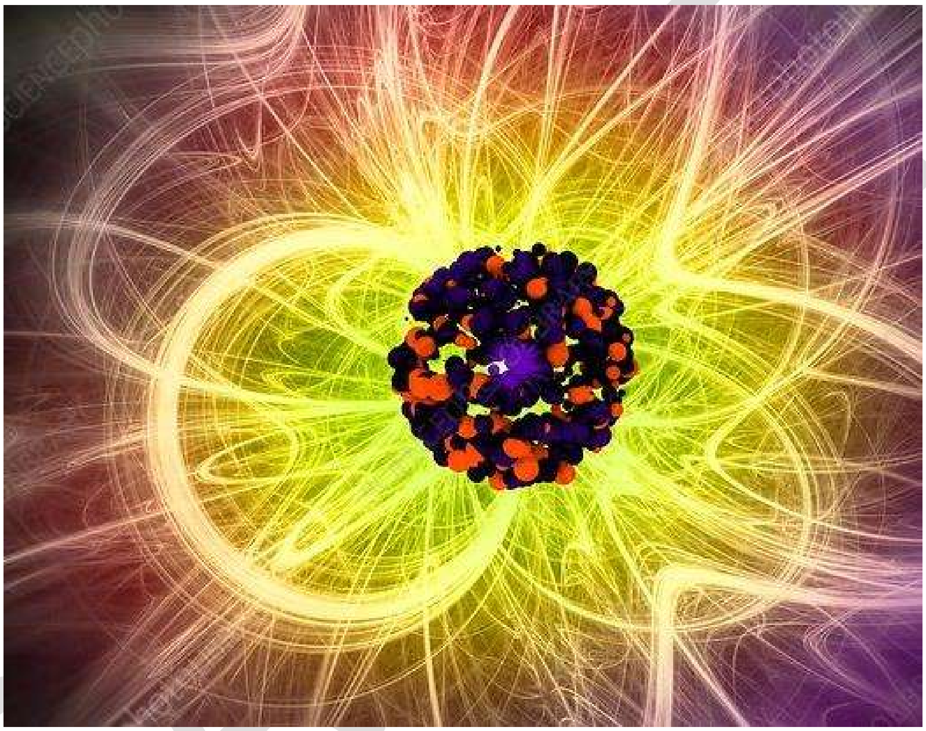

Figure **Error! No text of specified style in document.**.3. Image of high energy particles collision (Source: Science photo library, Creative Commons License)

Experimental teams, such as those that discovered W+, W, & Z quanta of weak force, can have 100 or more physicists from various countries working at European Laboratory for Particle Physics (CERN) in Geneva, that is supported by its 20 European member states. Their efforts' enormous volumes of data are interpreted and sorted using various visual and electronic approaches, & particle-physics laboratories are major consumers of the most cutting-edge equipment, whether supercomputers or superconductive magnets (Pai & Springett, 1993).

Math is a logical tool that theoretical physicists use to build theories & compute predictions of theories to compare with experiments. For example, Newton developed integral calculus to address following issue, that was crucial to the development of his theory of law of universal gravitation: If attractive force between each pair of point particles is inversely equal to square of distance between them, how can an item nearby be drawn to a spherical dispersion of particles like the Earth? Integral calculus, a technique for combining many little contributions, leads to simple conclusion that Earth acts as a point particle with all of its mass concentrated in center. Dirac developed an equation for electron in modern physics that would combine quantum mechanics & special theory of relativity & foretell the existence of the at the time unidentified positive electron (or positron) (Rovelli, 2018).

2. Relations between Physics & Society & other discipline

1. Physics Influence on Related Disciplines

It is not unexpected that physics has significantly influenced other scientific disciplines, philosophy, worldview of developed world, &, of course, technology because it clarifies the most basic fundamental questions in nature that can be agreed upon (Krell et al., 2015).

An area of physics has progressed from basic to applied physics & then to technology anytime it has reached level of maturity where its fundamental components are understood in general principles. Thus, applied physics makes up most of the current classical physics research, and its concepts are at the foundation of many engineering specialties. Modern physics discoveries are translated into technical improvements and analytical tools for related areas with increasing velocity. For instance, emerging disciplines like radio, X, gamma-ray astronomy, quantum chemistry, and quantum optics, as well as analytical instruments like radioisotopes, spectroscopy, and lasers, all have their roots in fundamental physics (Hashweh, 1987).

Physics, especially Newtonian mechanics, has developed into paradigm of scientific method beyond its specialized applications, with its experimental & analytical approaches occasionally (and occasionally incorrectly) duplicated in areas unrelated to allied physical sciences. Large-scale scientific endeavors, such as astronomy & space exploration, have emulated some of organizational aspects of physics, partly because of triumphs of World War II's radar and atomic-bomb efforts (Van Houten et al., 1983).

The older classification of physics as natural philosophy proves the significant effect of physics on the branches of philosophy dealing with conceptual underpinnings of human perceptions & understanding of nature, like epistemology. Modern philosophy of science focuses mostly, but not solely, on physics fundamentals (Whitcomb et al., 2019). Newtonian physics, which adheres to this principle, is the foundation of determinism, the philosophical theory which holds that cosmos is gigantic machine that operates with strict causality and that every aspect of its future is decided by its current state. Moreover, physics has long been viewed as a paradigm for philosophical inquiry by the schools of materialism, naturalism, and empiricism. The logical positivists take an extreme stance, insisting that all relevant claims be expressed in the language of physics due to their profound mistrust of the reality of anything that is not immediately visible (Docktor & Mestre, 2014).

Determinism has been reexamined in light of the quantum theory uncertainty principle, and its various philosophical ramifications are still up for debate. The meaning of measurement is particularly difficult because current ideas and tests support some of the mainstream quantum theory's seemingly noncausal predictions in this area. Though physicists generally concur that quantum theory is true, they disagree on its exact meaning (Jena & Castleman, 2006).

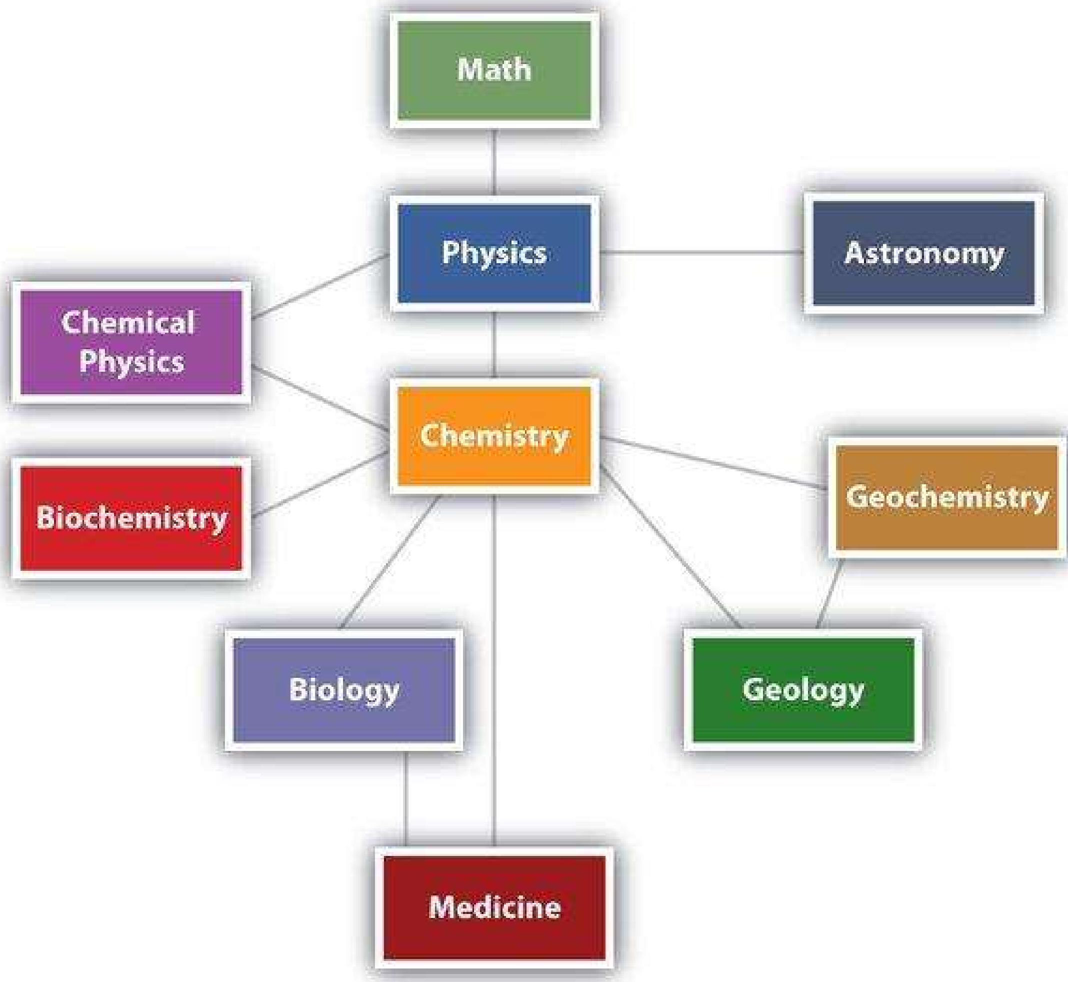

Figure **Error! No text of specified style in document.**.4. Flow diagram of physics influence on related disciplines (Source: Bracy Erin Harvey, Creative Commons License)

2. Related Disciplines Influence on Physics

A relationship between the areas of physics and its neighbors is beneficial. In a similar way to how technology relies on fundamental research to make new, beneficial discoveries, physics embraces techniques & tools of modern technology to progress itself. As a result, experimental physicists employ more advanced and precise electronic machinery. They also work closely with engineers to create basic scientific equipment like high-energy particle accelerators (Solbes & Vilches, 1997). A primary tool of theoretical physicists has always been mathematics. Even esoteric areas of mathematics like group theory & differential geometry have proven invaluable to theorists categorizing subatomic particles or examining symmetry properties of molecules & atoms. Modern physics research is heavily reliant on fast computers. It enables the theorist to carry out computations that are too time-consuming or difficult to complete with pencil & paper. Additionally, it makes it possible for experimenters to incorporate a computer into their apparatus so that measurements can be practically immediately supplied online as summary data while an experiment is being run (Xia et al., 2011).

3. Physicist in Society

Because modern physics relies heavily on advanced mathematics and is often disassociated from everyday experience, it has occasionally appeared to the general public that physicists are initiates of a modern-day secular priesthood who speak an obscure language and find it extremely difficult to explain their findings to laypeople. However, since World War II especially, physicists have played a more significant role in society. Governments have provided significant funding for research at academic institutions as well as at government laboratories (Brack, 1993). This funding has been provided through organizations such as the National Science Foundation and the Department of Energy in the United States. The Department of Energy has also established several national laboratories, one of which is a Fermi National Accelerator Laboratory in Batavia, Illinois, which houses one of the largest particle accelerators in the world. The 14-nation CERN organization runs a huge accelerator on the Swiss-French border. Japan Society for Promotion of Science & Max Planck Society for Advancement of Science fund physics research in their respective countries. An International Center for Theoretical Physics, closely related to developing nations, is in Trieste, Italy. These're merely few instances of global interest in fundamental physics (Jusup et al., 2022).

Since funding and support from the public are necessary for basic physics research, there has been a gradual increase in physics community's understanding of scientists' social responsibility for effects of their work & more systemic issues involving society & science (Galvin et al., 2004).

4. Importance Of Physics To Man And The Society

Physics, the study of matter, energy, and their interactions, is a global endeavor that will be crucial to advancing humanity in the future. Funding physics education and research worldwide is crucial because physics is a stimulating intellectual endeavor that piques the interest of young people and pushes the boundaries of our understanding of the natural world (Menter, 1972).

Of all the physical sciences, physics is the most fundamental. We understand science in terms of the ideas generated in physics, from chemistry and geology to biology and cosmology. Additionally, many instruments are directly responsible for the advancements in science and technology. Future technological advancements have always been based on the concerns and interests of physicists (Casimir, 1973).

Nuclear magnetic resonance imaging, radioisotopes, and X-rays are all used in medicine. Additionally, improvements in physics are necessary for the development of lasers, electron microscopes, synchrotron radiation, and electronics. Without computers, where would our contemporary Western economies be?—Without an understanding of quantum mechanics, it would be impossible to construct the circuits that power current computers. Compared to earlier historical periods, our modern world is much more connected. These days, we conduct business globally, travel widely, and communicate swiftly. The modern, interconnected globe has virtually reached every location on Earth (Arnott, 1863).

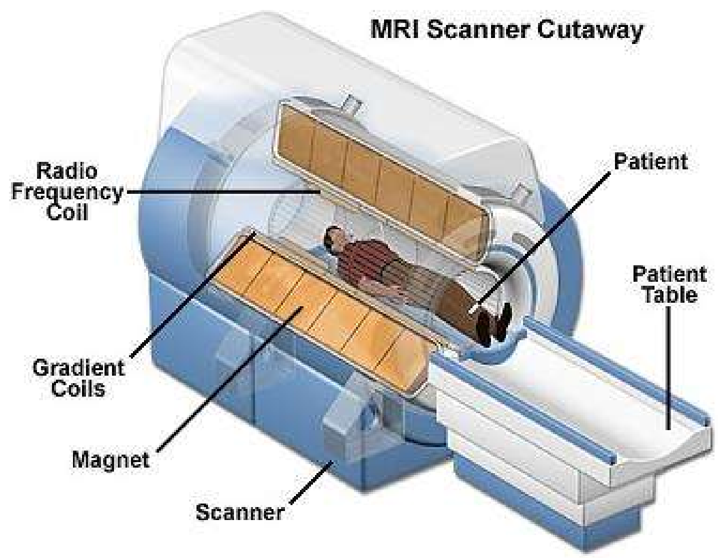

Figure **Error! No text of specified style in document.**.5. Illustration of process of magnetic resonance imaging (Source: PMF IAS, Creative Commons License)

Modern technology connects us to physics, but Mother Nature connects us to physics on a more fundamental level. A good example is the tsunami in Sumatra, Indonesia. In addition to being disastrous for the immediate area, the laws of physics caused this tsunami to move across Indian Ocean, killing more than 300,000 people in Southeast Asia and injuring more than 500 more people in more than 30 other nations. This was an illustration of the physical law (Gonsalves et al., 2016).

The world is still very divided, despite the abundance of evidence which physics has played significant role in connection of all regions of the planet. In industrialized nations, the average capital income is $30,000, the percentage of literacy is almost 100%, and the life expectancy is 80. In contrast, you will find lower than 50% literacy rates, mean capital incomes of around $2,000, and life expectancies of 40 in poor countries. To achieve equivalence with that interactivity, physics, the scientific community, and governments still have a lot of work to do (Li & Singh, 2021).

The UN Secretary-General, Kofi Anna, has quickly drawn attention to the recurring catastrophes occurring in the poor world that are directly related to illness, poverty, and environmental deterioration. He also quickly points out that many of these issues can be traced to the lack of access to technology, physics, and other sciences. Unfortunately, the scientific community spends most of its effort creating solutions for the industrialized world even while developing countries host most of the world's population (Barton, 1936).

Physics has the potential to play a significant part in helping to solve many of the issues the human race is currently facing. Science may not have all the answers, but given that nuclear weapons have been developed and continue to threaten the world, they can undoubtedly be employed for benefit of all people.

Politics, socioeconomic circumstances, & public acceptability all undoubtedly contribute to country's development. However, advances in physics, engineering, and other scientific & technological fields can raise developing country to the level of a developed one. Just take a look at what physics has managed to achieve in the last 200 years (Lewis et al., 2016).

Physics can play a significant role in creating cleaner energies, technological improvements, and methods to mitigate climate change. So why do underdeveloped countries only allocate a little of their GDP to research and development in these fields? Is it because both industrialized and developing countries do not fully appreciate science's benefits, notably physics? Do they genuinely not want to acknowledge that our world needs to change drastically if we're going to avoid self-destruction?

Physics and technology must collaborate to find solutions to pressing issues, such as the need for new technologies that will lessen the harm to our planet, for plans to ensure that those in developing nations have the means to advance, for treatments for deadly diseases that still pose a threat, and for ways to deal with the growing demands we place on our resources before they run out. Physics plays crucial part in our contemporary society more than at any other moment in history (Herbing, 2002).

5. Scope of Physics

Below is a breakdown of how classical and modern physics are traditionally divided into several areas or fields (Lauterborn & Kurz, 2010).

1. Mechanics

Most people think of mechanics as study of how objects move (or do not move) in response to various pressures. Some people classify classical mechanics as a subfield of applied mathematics. It is divided into two parts: kinematics, which explains dynamics & motion, which investigates how forces interact to produce static equilibrium (the latter being the science of statics) or motion (Atkinson, 2015). This section will cover various mechanics, including quantum mechanics, which is essential for understanding structure of matter, superfluidity, subatomic particles, superconductivity, neutron stars, & other major phenomena, & relativistic mechanics, which is significant when speeds approach the speed of light (Laird, 1986).

In classical mechanics, body dimensions, forms, and other inherent characteristics are disregarded as the principles are initially developed for point particles. As a result, even massive objects like Earth & Sun are considered point-like in the first approximation, for instance, when calculating planetary orbital motion. The extension and mass distributions of bodies are also examined in rigid-body dynamics, but they are presumed to be deformable. In contrast to hydrostatics and hydrodynamics, which deal with fluids at rest and in motion, respectively, elasticity is the mechanics of deformable solids (Fuchs et al., 2014).

The foundation of classical mechanics is made up of the three laws of motion described by Isaac Newton and & knowledge that forces are directed quantities (vectors) that combine in appropriate ways. The first law of motion, commonly known as the law of inertia, stipulates that an object at rest will remain at rest and an object in motion will continue to move ahead in a straight line at a constant speed until an external force acts upon it. This law indicates that an item in motion will continue to move forward in a straight line at a constant speed. Therefore, uniform motion does not need a cause. As a result, mechanics focuses less on motion per se and more on how an object's state of motion changes due to net force acting upon it (Allcock, 1969). According to Newton's second law, an object's momentum, determined by its mass and velocity, changes at a rate equal to the net force acting on it. 3rd Newton's law, known as law of action and reaction, asserts that when two particles interact, their forces are equal in size& directed in opposite direction. Suppose all of these mechanical principles are taken into account. In that case, it should be possible to predict the future motions of a group of particles as long as we are aware of their current state of motion external & internal forces acting on them. In the past, significant (and certainly wrong) philosophical inferences have been taken from the deterministic nature of the rules of classical mechanics and even related to the history of humanity (Nosonovsky & Bhushan, 2008).

At most fundamental level of physics, rules of mechanics are characterized by several symmetry features, e.g., symmetry between action & reaction forces stated earlier. Other symmetries exist in classical and relativistic mechanics and, to a limited extent, quantum mechanics. These symmetries include invariance (i.e., unchanging form) of laws under space-based rotations & reflections, time-based reversals, & transformations to different regions of space or times (Friedrich & Friedrich, 2006). It may be demonstrated that the symmetry qualities of the theory have mathematical ramifications known as conservation laws, that claim stability in a time of values of particular physical quantities under predetermined conditions. A most crucial quantities in physics are called conserved quantities; these include energy & mass (because of relativity theory, energy & mass are equivalent & conserved jointly), angular momentum, momentum, & electric charge (Mermin, 1998).

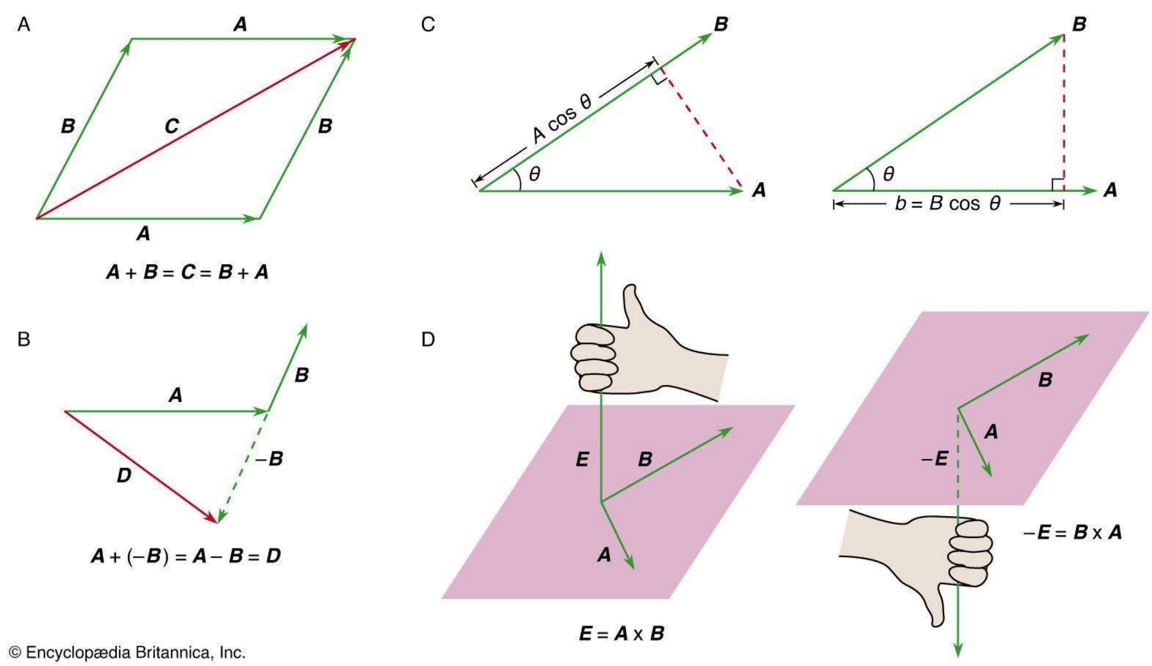

Figure **Error! No text of specified style in document.**.6. Example of mechanics (Source: David L, Creative Commons License)

Remember:

The laws of mechanics govern the motion of objects in the world around us.

2. Study of Gravitation

For historical reasons, because Newton brought both areas to high level of perfection, & because of its universal nature, this area of research has historically been categorized as belonging to classical mechanics. According to Newton's law of gravitation, which states that every solid particle in the universe is attracted to every other one, the intensity of the force that is exerted along the line that separates them is directly proportional to the product of their masses and inversely proportional to the square of their spacing (Yamakawa et al., 1992). This is because every solid particle in the universe is attracted to every other one. The first achievement of classical mechanics was Newton's thorough explanation of orbits of planets & Moon, & more subtle gravitational effects like equinoxes tides & precession (a slow, cyclical change in direction of Earth's axis of rotation). Rocketry and space flight fundamentals can be understood without additional concepts, but of course, these endeavors demand great technological prowess) (Cook, 1988).

The general theory of relativity, which Albert Einstein developed, is the name of the current gravitational theory. As a result of long-known equality of quantity "mass" in Newton's 2^{nd} law of motion & that in his gravitational law, the thought that acceleration may temporarily cancel a gravitational force (as happens when astronauts are supposedly weightless in a spaceship orbiting the Earth) fascinated Einstein. This led him to concept of curved space-time (Campanelli et al., 2007). Since it was finished in 1915, theory has been admired for its mathematical elegance and ability to predict a few occurrences, such as how light is bent by gravity around huge object. However, it has only recently emerged as a crucial theoretical and experimental investigation area. (The term "relativistic mechanics" is used to refer to Einstein's special theory of relativity, which should not be confused with a theory of gravitation) (Ward et al., 2009).

3. Study of Thermodynamics

Heat is internal energy connected to radiation or the erratically moving molecules that make matter. The energy of molecular binding and rotation is not included in the definition of temperature, which is an average of portion of internal energy in a body. Absolute zero (273.15 °C or 459.67 °F) is substance's lowest attainable energy state. Thermal equilibrium refers to the eventual attainment of homogeneous temperature by an isolated body and two or more bodies placed in touch. Thermodynamics is scientific study of states of matter at (or near) thermal equilibrium. It can be used to analyze a variety of thermal systems without taking into account their particular microstructures (Izgorodina et al., 2007).

Tip: When studying thermodynamics, it can be helpful to understand the practical applications of the concepts being learned.

1. First law

The thermodynamics first law is generalization of the mechanics' concept of energy conservation, which states that energy remains constant for all changes in an isolated system (Lustig, 2006).

2. Second law

According to the second rule of thermodynamics, without the help of an outside object (like a refrigerator), heat cannot go from a region with a lower temperature to one with a higher one. The measurement of the degree of disorder among system's constituent particles is central to the idea of entropy. For instance, a coin toss results in seemingly random series of heads & tails, which has a higher entropy than heads & tails that tend to cluster. Another way to state 2nd law is that an isolated system's entropy never diminishes over time (Caton, 2000).

3. Third law

According to the third law of thermodynamics, the most ordered conceivable state has an entropy of zero at absolute zero of temperature (Giauque & Stout, 1936).

Activity 1.1.

In designing a new rollercoaster, how can physics be applied to ensure a thrilling ride without compromising the safety of the passengers?

Summary

The chapter "Physics: Foundation of Science" covers various topics related to the discipline of physics. The chapter discusses the methodology of physics and its contribution to scientific research. It explains the scientific method, hypothesis testing, and the importance of experimental and theoretical approaches in physics research. The chapter explores the relationships between physics and other disciplines such as mathematics, chemistry, and biology. It highlights the influence of physics on these fields and vice versa, such as the application of physics principles in engineering and technology.

The role of physicists in society is also discussed in the chapter. It emphasizes the contributions of physicists in developing new technologies and solving societal challenges, such as energy and climate change.

The scope of physics is discussed in the chapter, including its various subfields such as mechanics, gravitation, and thermodynamics. It provides an overview of each subfield and their applications in different areas. The chapter also covers the laws of thermodynamics and their significance in physics. It explains the first, second, and third laws of thermodynamics and their applications in energy conversion and heat transfer processes. Overall, the chapter provides a comprehensive introduction to the discipline of physics and its various aspects, from its methodology to its applications in different fields.

Multiple Choice Questions

1. Which of the following statements best describes the methodology of physics?
1. It relies solely on experimentation and observations.
2. It relies solely on theoretical models and calculations.
3. It combines experimentation, observations, and theoretical models.
4. It relies solely on historical records and anecdotal evidence.
5. Which of the following fields is most closely related to physics?
1. Biology
2. Chemistry
3. Psychology
4. Sociology
5. Which of the following is an example of how physics has influenced other fields of study?
1. The discovery of DNA's structure by Watson and Crick.
2. The development of the internet by computer scientists.
3. The creation of MRI technology by medical physicists.
4. The development of the theory of natural selection by Charles Darwin.
5. Which of the following is a subfield of physics?
1. Psychology
2. Ecology
3. Mechanics
4. Anthropology
5. Which of the following is one of the laws of thermodynamics?
1. The law of natural selection
2. The law of relativity
3. The law of conservation of energy
4. The law of supply and demand
5. What is the significance of the laws of thermodynamics in physics?

1. They describe the behavior of particles at the atomic level.
2. They explain how forces affect motion.
3. They explain the behavior of heat and energy in systems.
4. They describe the relationship between mass and energy.

Answers to Multiple Choice Questions

1. (c) 2. (b) 3. (c) 4. (c) 5. (c)

6. (c)

Review Questions

1. What is the significance of the scientific revolution in the development of modern physics?
2. How did the Islamic world contribute to the development of physics?
3. What were the key discoveries in modern physics and what was their importance?
4. Explain the origin and principles of the theory of relativity.
5. What are the key concepts of wave-particle duality, uncertainty principle, and measurement problem in quantum theory?

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