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Quantum Mechanics

The ideology of quantum mechanics originated from a series of controversial mathematical experiment explanations that could not be properly explained. One of them being conflicting matters regarding the wave theory, light could behave like a particle while also behaving like a wave. Quantum mechanics is the physics that explains the nature of the particles that make up matter and the forces they interact with. Now unlike many scientific theories we know and practice today, there is no one individual scientist that was recognized for the development; however, a culmination of work from various scientists were used to developed the foundation of what we call quantum mechanics.

There are three fundamental principals one should be aware of when either studying or experimenting with quantum mechanics. The three revolutionary principles are quantized properties, particles of light, and waves of matter.

In the late 19th century, many physicists thought they could calculate the motions of material objects by utilizing Newton's Law of classical mechanics. They believed that by using mathematical relationships they could the properties of radiant energy. It wasn't till the phenomenon of blackbody radiation that they contradicted the theories of classic physics. German physicist, Max Planck, explained the ultraviolet catastrophe by proposing that the electromagnetic energy waves are quantized rather than continuous. What this meant was that each temperature possessed its own maximum intensity of radiation that is emitted in a blackbody object. In light of Planck's explanations, quantization helped explained many other physics mysteries.

Shortly thereafter Planck's theory, Einstein utilized his studies and created the quantum theory of light. This theory suggests that light existed as tiny particles or packets, known as photons. The concept of light traveling not as a wave but, rather as energy quanta allowed Einstein to further investigate. Einstein utilized his model, he noticed that the energy jumped differently when he divided by Planck's constant. This allowed him to come to the conclusion of the difference in energy determined the color of light carried within those quanta. The insight provided by the nine distinct behaviors enabled a deeper understanding of how certain colors of light could remove electrons from metal surfaces, this was known as the photoelectric effect.

In 1896, the discovery of the electron has enable scientists to understand that all matter existed as a culmination of particles. With the conflicting matter of the duality of light behavior, the question of whether or not matter was limited behaving as particles arose. French physicist, Louis de Broglie, exhibited wave-like characteristics utilizing Einstein's theory of special relativity. Later on, Austrian physicist, Erwin Schrodinger, expanded on Broglie's reasoning and developed the theory of wave mechanics. Schrodinger modeled the atom so that each electron behaves as a wave surrounding the nucleus of the atom, replacing Rutherford-Bohr's model.

The Schrodinger Equation is a linear partial differential equation that describes the wave function of a quantum mechanical system. There are two equations to keep in mind, the time-dependent equation and the time-independent equation.

The time-dependent schrodinger general equation

$$i\hbar\frac{\partial}{\partial t}\,|\,\Psi(\mathbf{r},t) = \hat{H}\,|\,\Psi(\mathbf{r},t)$$

Question: Determine the time-independent Schrodinger equation using the general time-dependent equation (Hint: Express a function of two variables as the product of two different functions).