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IB Physics 3

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Nobel Prize Essay: J. J. Thomson (1906)

Who

Joseph John Thomson, who was always called J.J., was born in Cheetham Hill, England, near Manchester, in 1856. His mother, Emma Swindells, came from a local textile family. He had a brother two years younger than he was, Frederick Vernon Thomson. His father was a bookseller who planned for Thomson to be an engineer. When an apprenticeship at an engineering firm couldn't be found, Thomson was sent to bide his time at Owens College at the age of 14. In 1876, he received a small scholarship to attend Trinity College at Cambridge to study mathematics. In 1880, he obtained his BA in mathematics. He applied for and became a Fellow of Trinity College as of 1881. Thomson received his MA in 1883.

Thomson worked in the Cavendish Laboratory after graduation, under the tutelage of Lord Rayleigh. Thomson was elected a Fellow of the Royal Society on 12 June 1884 and served as President of the Royal Society from 1915 to 1920. He was both respected and well-liked, and students came from around the world to study with him. On 22 December 1884 Thomson was chosen to become Cavendish Professor of Physics at the University of Cambridge. The appointment caused considerable surprise, given that candidates such as Richard Glazebrook

were older and more experienced in laboratory work. Thomson was known for his work as a mathematician, where he was recognized as an exceptional talent.

In 1890, Thomson married Rose Elisabeth Paget, daughter of Sir George Edward Paget, KCB, a physician and then Regius Professor of Physic at Cambridge. They had one son, George Paget Thomson, and one daughter, Joan Paget Thomson.

He was awarded a Nobel Prize in 1906, "in recognition of the great merits of his theoretical and experimental investigations on the conduction of electricity by gases." He was knighted in 1908 and appointed to the Order of Merit in 1912. In 1914 he gave the Romanes Lecture in Oxford on "The atomic theory". In 1918 he became Master of Trinity College, Cambridge, where he remained until his death. Joseph John Thomson died on 30 August 1940 and was buried in Westminster Abbey, close to Sir Isaac Newton.

One of Thomson's greatest contributions to modern science was in his role as a highly gifted teacher. One of his students was Ernest Rutherford, who later succeeded him as Cavendish Professor of Physics. In addition to Thomson himself, seven of his research assistants and his son won Nobel Prizes in physics. His son won the Nobel Prize in 1937 for proving the wavelike properties of electrons.

What

The idea that electricity was transmitted by a charged smallest unit related to the atom was put forward in the 1830s. In the 1890s, J.J. Thomson made experiments with charged particles in gases and managed to estimate its magnitude. In 1897 he showed that cathode rays, radiation emitted in a low pressure glass tube when a voltage is applied between two metal

plates, consist of particles, electrons, that carry electricity. Thomson also concluded that electrons were part of the atom.

Where

Thomson born in Cheetham Hill, England, near Manchester. In 1870 he was admitted to Owens College. He moved on to Trinity College, Cambridge in 1876. On 22 December 1884 Thomson was chosen to become Cavendish Professor of Physics at the University of Cambridge.

When

Several scientists, such as William Prout and Norman Lockyer, had suggested that atoms were built up from a more fundamental unit, but they envisioned this unit to be the size of the smallest atom, hydrogen. Thomson, in 1897, was the first to suggest that the fundamental unit was more than 1,000 times smaller than an atom, suggesting the subatomic particle now known as the electron.

Why

Thomson discovered this through his explorations on the properties of cathode rays. Thomson made his suggestion on 30 April 1897 following his discovery that Lenard rays could travel much further through air than expected for an atom-sized particle.

How

He estimated the mass of cathode rays by measuring the heat generated when the rays hit a thermal junction and comparing this with the magnetic deflection of the rays. His experiments suggested not only that cathode rays were over 1,000 times lighter than the hydrogen atom, but also that their mass was the same in whichever type of atom they came from. He concluded that

the rays were composed of very light, negatively charged particles which were a universal building block of atoms. He called the particles "corpuscles", but later scientists preferred the name electron which had been suggested by George Johnstone Stoney in 1891, prior to Thomson's actual discovery.

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