Name: _____ **Date:** _____

Chemistry *~ Ms. Hart* **Class:** Anions or Cations

THE URBAN ASSEMBLY SCHOOL FOR CRIMINAL JUSTICE

3.3 Thomson Reading

Cathode Ray Experiment - The Electric Experiment by J.J. Thompson
by Martyn Shuttleworth (Sep 22, 2008)

JJ Thomson

Like most scientists of that era, he inspired generations of later physicists, from Einstein to Hawking.

His better-known research proved the existence of negatively charged particles, later called electrons, and earned him a deserved Nobel Prize for physics. This research led to further experiments by Bohr and Rutherford, leading to an understanding of the structure of the atom.

WHAT IS A CATHODE RAY TUBE?

Even without consciously realizing it, most of us are already aware of what a **cathode ray tube** is.

Look at any glowing neon sign or any 'old-fashioned' television set, and you are looking at the modern descendants of the cathode ray tube.

Physicists in the 19th century constructed a glass tube with wires inserted in both ends. They pumped out as much of the air as they could to create a vacuum. They applied a voltage across these glass tubes in which they had various sealed gases in it, such as neon and helium. The electric charge passed across the tube from the wires which would create a fluorescent glow. This cathode ray also became known as an 'electron gun'.

Thomson's First Cathode Ray Experiment

He conducted an experiment to prove that the rays carried a negative charge. To prove this hypothesis, he attempted to deflect them with an electric field and a magnetic field.

For this, he constructed a cathode ray tube as described above. Halfway down the tube were two electric plates, a positively charged and negatively charged plate, which he hoped would deflect the rays.

As he expected, the rays were deflected by the electric charge. The rays were deflected away from the negative plate and towards the positive plate.

In addition, he used a magnet to gather additional evidence. One side of the magnet bent the rays away from the magnet, while the other side bent the rays towards the magnet.

This proved that the rays were in fact made up of charged particles, and because the rays were deflected by the negative side of the electric plate, and he knew that like charges repel each other, he could conclude that these charged particles carried a negative charge. This result was a major discovery in itself, but Thomson resolved to understand more about the nature of these particles.

Thomson's Other Experiments

The next experiment was a brilliant piece of scientific deduction and shows how a series of experiments can gradually uncover truths. Many great scientific discoveries involve performing a series of interconnected experiments, gradually accumulating data and proving a hypothesis.

He attempted to discover more about the nature of the particles. They were too small to have their mass or charge calculated directly, but he attempted to deduce this from how much the particles were bent by electrical currents, of varying strengths.

Thomson found out that the charge to mass ratio was so large that the particles either carried a huge charge, or were a thousand times smaller than a hydrogen atom, which was the smallest particle known to scientists at the time. He decided upon the latter and came up with the idea that the cathode rays were made of particles that emanated from within the atoms themselves, a very bold and innovative idea.

He also measured this charge to mass ratio for many different gases flowing through the tube. What he found was that the ratio of the charge of an electron to its mass was constant; it did not depend on the kind of gas in the cathode ray tube or the type of metal he used for the electrodes. Thomson concluded that electrons must be parts of the atoms of all elements.