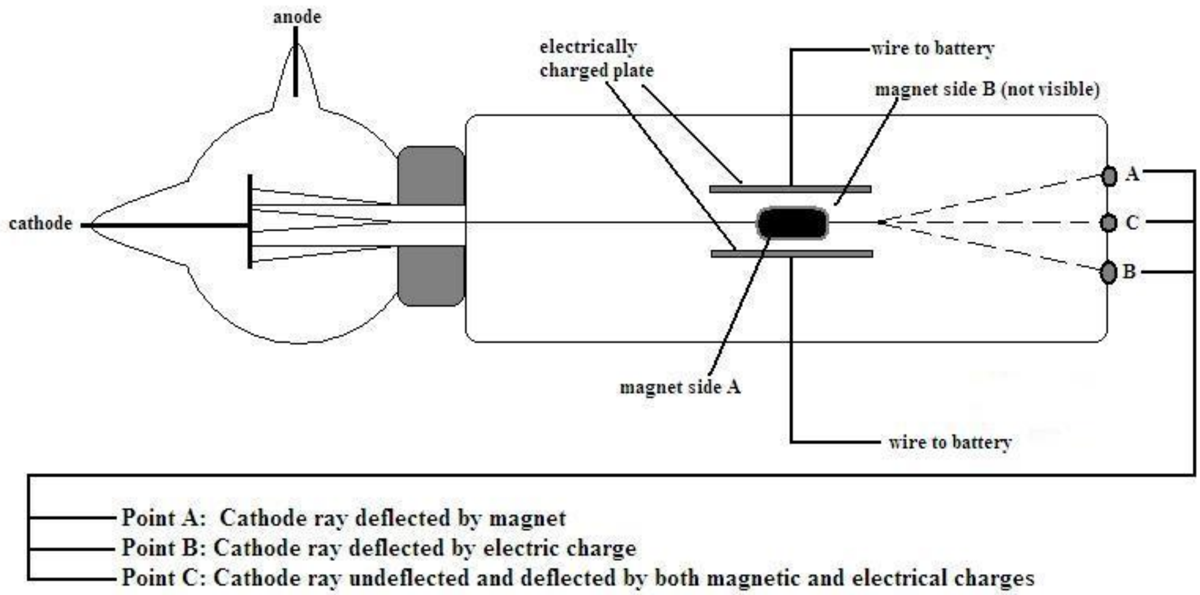
Experiment 1:

Thomson surrounded the cathode ray tube with a magnetic field and had sensors to measure small electrical charges (electrometers). The electrometers measured no change with magnets on the tube, indicating that the cathode rays had been bent by the magnetic field and therefore had negative charge.

Diagram of cathode ray tube (with magnets)



To find the charge to mass ratio of the electron using the cathode ray tube with both electric and magnetic fields, the following equation is used.

$$\frac{e}{m} = \frac{V\theta}{B^2 * ld}$$

Where *e*/*m* is the charge to mass ratio of the electron (in Coulombs/kilogram, C/kg); *V* is the electric potential (in volts, V) applied across the charged plates; θ is the angle of deflection; *B* is strength of the applied magnetic field (in Teslas, T); *l* is the length of the charged plates (in meters, m), and *d* is the distance between the charged plates (in meters, m).

For example, if a magnetic field of $5.5*10^{-4}$ T produced a deflection angle of 11°, with a distance of 1.5 cm between charged plates of 5 cm in length; and a potential of 200 V applied across the plates, what would be the *e*/*m* for the electron.

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> B:=5.5*(10^-4);
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$$0.0005500000000$$

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> θ:=(11*Pi)/180;
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$$\frac{11}{180}\pi$$

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> d:=0.015;
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$$0.015$$

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> l:=0.05;
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$$0.05$$

```
> V:=200;
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$$200$$

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> cmr:=(V*θ)/((B^2)*l*d);
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$$5.387205387\,10^{10}\,\pi$$

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> evalf(%);
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$$1.692440487\,10^{11}$$

Thus for the electron,

$$\mathbf{e/m = 1.69244048710*10^{11}\ C*kg^{-1}}$$

<u>Experiment 1results</u>:

In the first experiment, a ray was fired in a cathode ray tube that was surrounded by a magnetic field. The results showed that there was no charge reading on the far side of the cathode ray tube.