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Integration Using Electrical Field Of Rod along Equatorial Point

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Abstract
The estimation of an integral is integration. Math integrals are used to classify several useful numbers, such as regions, numbers, displacement etc. When we talk about integrals, they are commonly connected to definite integrals. For anti-derivatives, infinite integrals are used. Integration is one of the two key calculus topics in mathematics, apart from differentiation (which measures the rate of change of any function with regard to its variables, and electricity can be produced by motion by magnetism. He found that a tiny electric current flows through the wire when a magnet was pushed within a coil of copper wire. Here we discuss how integration helps in calculus and find electric field of rod along equatorial point

Keywords: *Differentiation, Integration, Vector, Scalar, Electric Field, Charge and Limit.*

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I. Introduction:

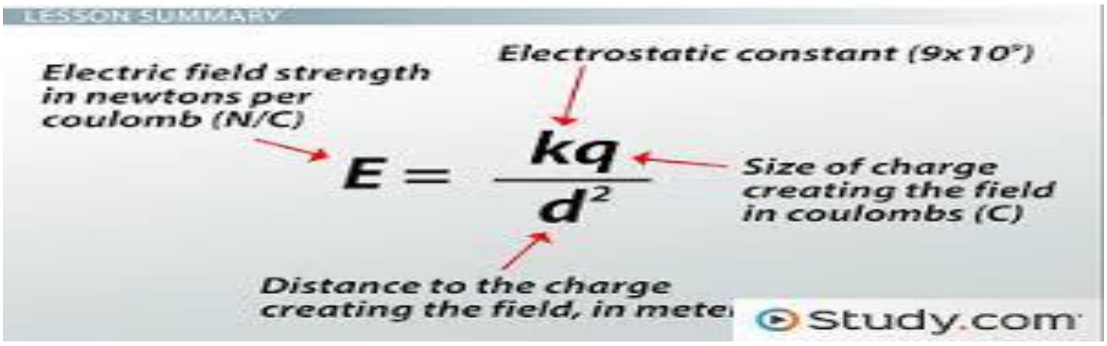
In the 17th century, the main advance in integration came with Leibniz and Newton's separate discovery of the fundamental theorem of calculus. Before Newton, Leibniz published his thesis on calculus. It made it possible for precise analysis of functions inside continuous domains, given the name infinitesimal calculus.

Faraday sought the solution in 1831. Electricity could be produced by motion by magnetism. He noticed that a tiny electrical current passes through the wire as a magnet is passed inside a coil of copper wire. H.C, H.C. Oersted proved, in 1820, that electric currents create a magnetic field.

Preliminaries:

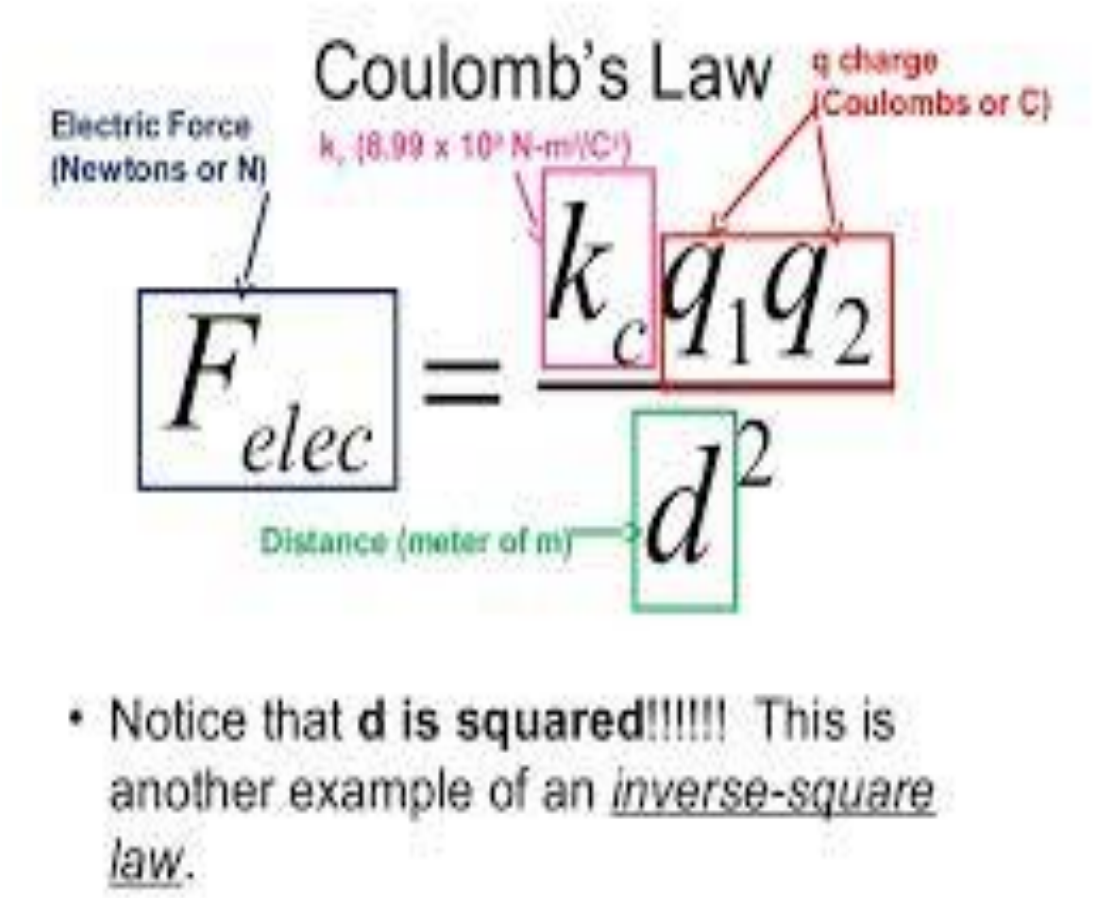
1.1 ELECTRIC FIELD:

The electric field per unit charge is known as the electric power. The field's position is taken to be the direction of the force on a positive test charge that it will exert. From a positive charge, the electrical field is radically outward and radically towards a negative point charge.



1.2 COLUMBS INVERSE SQUARE LAW:

Coulomb's law or Coulomb's inverse-square law is experimental *law* of physics that quantifies the amount of force between two stationary, electrically charged particles. In the case of a single stationary point charge, the two laws are equivalent, expressing the same physical law.



A point charge produces an electric field given by the formula $\vec{E} = \frac{kQ}{R^2}\frac{\vec{R}}{R}$ and a electric potential given by the formula, $V = \frac{kQ}{R}$, where Q is the charge and $\vec{R}$ is the vector distance from the charge to the field point P where we want to calculate the field or potential (see Figure 1). We find the electric field or potential due to a charged wire by considering it to be made up of many infinitesimally small pieces of length dS each containing charge dQ (see Figure 2). Note that $\vec{R}$ will be different for each different piece of the wire. We will need to sum up each infinitesimal contribution via an integral.

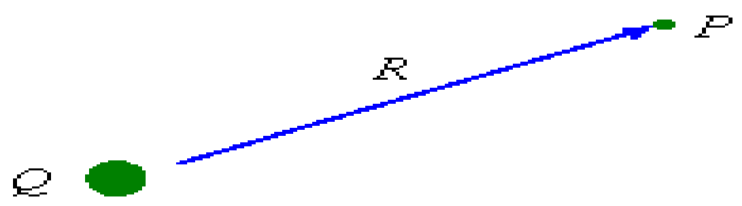


Fig. 1. Charge Q and field point

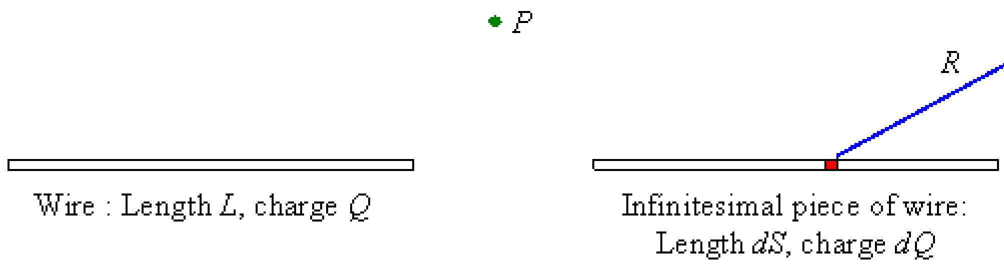


Fig. 2. A wire as a series of infinitesimal point charges.

There are a number of steps to properly constructing the Integral for a straight wire:

- Choose a coordinate system and origin. If there is a lot of symmetry, put the origin at the symmetry point.
- If the wire lies on the *x* axis in your coordinate system, then choose an arbitrary piece of the wire and say it is distance *x* from the origin where *x* is your variable of integration. The size of the piece will then be *dx*. Note that *x* should be an arbitrary positive point – not the ends or middle.
- ·The limits of integration are the values of *x* for the ends of the wire.

1.3: Calculations of the Electric field:

We can take a Rod of length L with a charge Q in it. Let λ be linear mass density of it. Now we are required to calculate Electric field at point p which is perpendicular to the plane of Rod. To finding the Electric field with the help of the integration. Consider a very small part of the rod of length "dl "and containing charge "dq" with perpendicular line (OP). So electric filed along is also small that is "dE". The perpendicular distance to p is "a" and the distance between O to X be "l" and r be the distance between dq and p. we can get figure 3.

We know that Electric field $\bar{E} = \frac{F}{r^2}$

We get $\bar{E} = k\,\frac{q}{r^2}$

Where q is charge of the material
r is distance between charge and point

So that above equation can be written as $d\bar{E} = k\,\frac{dq}{r^2}$ -----(1)

Let us take constant $\lambda = \frac{q}{l}$ we get $dq = \bar{E} = k\,\frac{dq}{dl}$

Implies $dq = \lambda\, dl$ ------(2)

Substituting these value in equation (1)

We get $d\bar{E} = k\lambda\,\frac{dq}{r^2}$ ------(3)

From the figure 3 we get $r = \frac{a}{\cos\phi}$

From equation (3) after simplification we get $d\bar{E} = \frac{k\lambda}{a}\, d\phi$ -----(4)

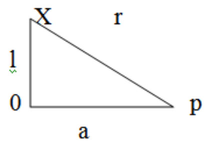


Figure-3

IF we resolute $d\bar{E}$ in to $d\bar{E}\sin\phi$, $d\bar{E}\cos\phi$ as $\overline{dE_y}$ and $\overline{dE_x}$ after integrating and sum them up we get required Electric Field.

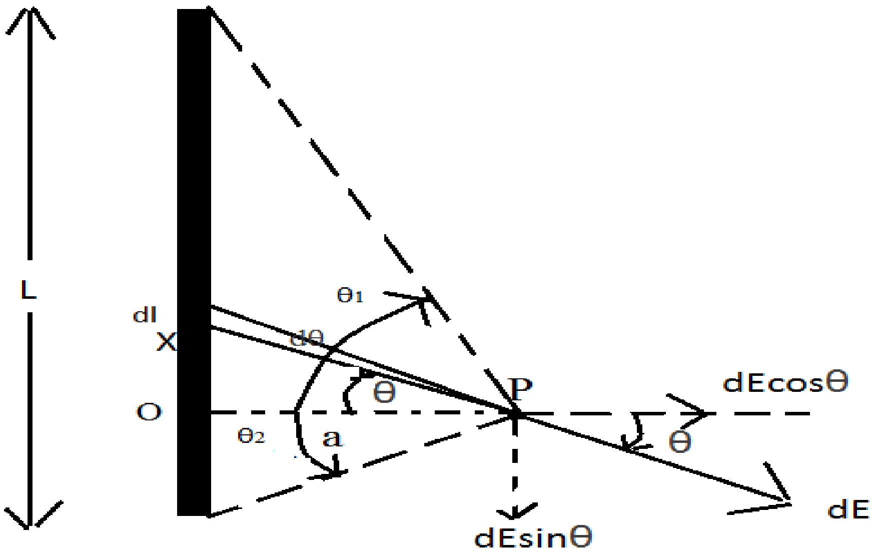


Figure -4

From the above diagram
Along x- axis :

We get $\overline{E_x} = \frac{k\lambda}{a}$ [sin $\emptyset_1$+ sin$\emptyset_2$] -------(5)

Along y- axis

We get $\overline{E_y} = \frac{k\lambda}{a}$ [cos$\emptyset_2$- cos$\emptyset_1$] --------(6)

Finally we get $E_{net} = \sqrt[2]{\overline{E_x}^2 + \overline{E_y}^2}$ then we are getting total Electric Field of the rod.

II. Conclusion:

From these observations and calculations we can conclude that integration plays a crucial role in identifying the accurate value of the electric fields along extended objects like uniformly charged rod, bent rod in the form of arcs with certain angle at centre and many more shapes. In our paper we proved taking straight line rod and finding electricity along the rod. By these observations we can acknowledge the soul purpose of integration is to join the values of very small parts from start to end by inserting them as limits into the proof.

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