Victoria University of Bangladesh

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Answer to the question number: 08

(a)

Gauss Law : Gauss law, either of two statements describing electric and magnetic fluxes. Gauss's law for electricity states that, the electric flux Φ across any closed surface is proportional to the net electric charge q enclosed by the surface. That is, $\Phi = q/\epsilon_0$.

Where ϵ_0 is the electric permittivity of free space and has a value of 8.854×10^{-12} square columbs per newton per square meter. The law implies that isolated electric charges exist and that like charges repel, one another while unlike charges attract. Gauss's law for magnetism states that, the magnetic flux B across any closed surface is zero. that is div $B = 0$ where div is the divergence operator. This law is consistent with the observation that isolated magnetic poles (monopolies) do not exist.

Mathematical formulations for these two laws – together with Ampere's law (concerning the magnetic effect of a changing electric field or current) and Faraday's law of induction (concerning the electric effect of a changing magnetic field) are collected in a set is known as maxwells equations which provide the foundation unified electromagnetic theory.

Answer to the question number: 01 (b)

Gauss's Law:

Gauss's law is a very important law that describes that the properties of electric fields, magnetic fields and gravitational fields. The Gauss's law for electric fields states that the electric fields states that the electric flux ~~over the surface~~ through any closed surface is proportional to the electric charge enclosed by the surface. It can be expressed as $\Phi = q/\epsilon_0$ where Φ is the total electric flux over the surface. q is the charge enclosed by the surface and ϵ_0 is the dielectric constant. To understand this concept of electric flux. The electric flux over the surface is a measurement of the number of electric field inc. passing through a surface.

This is directly proportional to the number of electric field lines across the surface. The Gauss's law for the magnetic fields is a very important law. The Gauss's law for magnetic fields states that, the total magnetic fields flux over any closed surface is zero. This is because magnetic monopoles do not exist. Magnetic poles only exist as dispoles. In any given closed surface the net magnetic polarity is zero. Therefore, the magnetic flux over any closed surface is zero,

Coulombs law :

Coulombs law is a law desribing the interactions between electrically charges particles. This states that, the force between two electrically charged particle is proportional to the changes and inversely proportional to the square of the distance between the two

Particles. This can be expressed using the equation $F = Q_1 Q_2 / 4\pi r^2 \epsilon_0$ where Q_1 and Q_2 are the charges and ϵ_0 is the dielectric constant of free space. If this equation is defined for a medium other than free space, ϵ_0 should be replaced with ϵ, where ϵ is the dielectric constant of the medium. If these charges were of the same sign, F would be a positive value.

Answer to the question number : 01

(a)

Dielectric strength is defined as the electrical strength of an insulting material. In a sufficient strong electric field in the insulating properties of an insulator breaks down allowing ~~few~~ flow of charge. Dielectric strength is measured as the maximum voltage required to produce a dieletric flux ϕ accross any closed surface is proportional to the net electric charge q enclosed by the surface that is $\phi = q/\epsilon_0$.

where e_0 is the electric permittivity of free space and has a value of 8.854×10^{-12} square coulombs per newton per square metre.

Dielectric strength = V/m , here v is the voltage and m is the thickness per unit. The dielectric strength is defined as the maximum voltage that can be aplied to an insulating material before it goes into between or losses it's insulating properties. Also, refferred to as relative permittivity of a material, the dielectric constant is the ability of an insulating material to store electrical energy. The purpose of a dielectric strength test is to reach the point of breakdown or failure. This happens when the material experiences a sudden change in its resistance. to the test voltage. The level of voltage where the barrier allows current to flow.

is the dielectric strength of the material. It's basically the number of field lines that pass through surface, more fields lines means a larger flux. so, for example : you could use Gauss's law to figure out the electric field created by a charged conducting sphere. In that cases, you have a charge sorrounded by a spherical surface. The dielectric test sets measure leakage current while applying a dc voltage at or above the insulation system's operating level. This measurement aids in dettermining the insulation system's ability to with stand over voltages such as lighting strikes and switching Surges.

Answer to the question number : 2

(a)

OHM's Law :

The current that follows through most substances is directly proportional to the voltage V applied to it. The ~~item~~ German physicist Georg simon ohm (1787 – 1854) was the first to demonstrate experimentally that, the current in a meatal wire is directly proportional to the voltage applied.

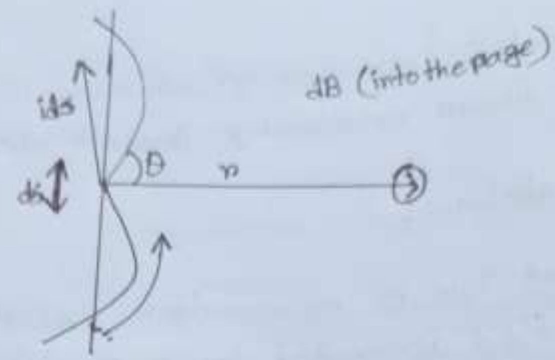
$$I \propto V$$

This important relationship is the basis for Ohm's law. It can be viewed as a cause and effect relationship with voltage the cause and current the effect. This is an empirical law, which is to say that, it is an experimentally observed phenomenon like friction. Such a linear relationship doesn't always occur

Biot - Savart Law :

Biot savant law is an equation describing the magnetic field generated by a constant electric current. It relates the magnetic field to the magnetude, direction, length and proximity of the electric current. The biot - savant law states how the value of the magnetic field at a specific point in space from one sort segment of current - carrying conductor depends on each factor that influences the field.

Biot - Savart's Law is an equation that gives the magnetic field produced due to a current carrying segment. This segment is taken as a vector quality known as the current element.



Consider a current carrying wire 'i' in a specific direction as shown in the above figure. Take a small element of the wire of length ds. The - direction of this element is along that of the current so that it forms a vector i ds. To know the magnetic field produced at a point due to this small element, one can apply Biot-Savarts law. Let the position vector of the point in question drawn from the current element be r and the angle between the two b θ. Then,

$$|dB| = (\mu_0 / 4\pi)\ (i\,dl \sin\theta / r^2)$$

Where μ_0 is the permeability of free space and is equal to $4\pi \times 10^{-7}$ H/m. The direction of the magnetic field is always in a plane perpendicular to the line of element and position vector. It is given by the right-hand thumb rule where the the thumb points to be the direction of conventional current and the other fingers show the magnetic field's direction:

Answer to the question number : 2

(b)

Ampere's Law:

The integral around a closed path of the component of the magnetic field tangent to the direction of the path equals μ_0 times the current intercepted by the area within the path —

$$\oint \vec{B} \cdot \vec{ds} = \mu_0 I$$

OR, in a simplified scalar form

$$\oint B_{\|} \cdot ds = \mu_0 I$$

Thus the line integral (circulation) of the magnetic field around some arbitrary closed curve is proportional to the total ~~amount~~ current enclosed by that curve. In order to apply Ampere's law, all currents have to be steady (i.e do not change with time), only ~~customer~~ currents crossing the area inside the path are taken into account and have some contribution to the magnetic field. Currents have to be taken with their algebraic sign (those going "out" of the surface are positive, those going "in" are negative) use right hand's rule to determine directions and signs. The total magnetic circulation is zero only in the following cases.

* The enclosed net current is zero.
* The magnetic field is normal to the selected path at any point, the magnetic field is zero.
* Ampere's Law can be useful when circulations with a high degree of symmetry.

Faraday's Law:

The electric fields and magnetic fields considered up to now have been produced by stationary charges and moving charges (currents) respectively. Imposing an electric field on a conductor gives rise to a current which in turn generates a magnetic field. One could the inquire whether or not an electric field could be produced by a magnetic field. In 1831, Michael Faraday discovered that, by varying magnetic field could be generated. The phenomenon is known as electromagnetic induction. Faraday showed that, no current is registered in the galvanometer when bar magnet is stationary with respect to the loop. However, a current is induced in the loop when a relative motion exist between the bar magnet and the loop. In particular, the galvanometer defects in one direction as the magnet approaches the loop and the opposite direction as it moves away.

Faraday's experiment demonstates that, ~~it~~ an electric current is ~~included~~ induced in the loop by changing the magnetic field. The coil behaves as if were ~~com~~ connected to an emf. source. Experimentally it is found that, the induced emf depends on the rate of change of magnetic flux through the coil.

Answer to the question number : 03

(a)

Quantum Theory :

Quantum theory is the theoretical basis of modern physics that explain the nature and behavior of matter and energy on the atomic and subatomic level. The nature and behavior of matter and energy at that level is sometimes referred to as quantum physics and quantum mechanics organizations in several countries have devoted significant resources to the development of quantum computing, which uses quatum theory to drastically improve computing capabilies beyond what is possible using todays classical computers. In 1900, physicist max planck presented his quantum theory to the German Physical society. Planck had sought to discover the reason that, radiation from a glowing body changes in colon from red to onnange - and finally to blue as its temperature rises. He found that, by making the assumption that energy existed in individual units in the game way that matter does, rather than just a constant electro-magnetic wave - as had been formenly assumed and was therefore, quantifiable, he would find the ~~matter~~ answer to this question. The existance of this units become the first assumption of quantum theory. Planck wrote a mathematical equation involving a figure to represent these individual units of energy. Which he called quanta.

Bohr atomic theory :

This model was based on the quantum theory of radiation and the ~~radiation~~ Classical law of physics. It gave new idea of automic structure in order to explain the stability of the atom and emission of sharp spectrall lines.

Postulates of this theory are :

(a) The atom has a central massive core nucleus where all the protons and neutrons are present; The size of the nucleus is very small.

(ii) The electron in an atom resolves around the nucleus in certain discrete orbits are known as stable obbits non-radiating or stationary orbits.

(iii) The force of attraction between the nucleus and the electron is equal to centrafugal force of the moving electron.

Force of attraction towards nucleus = centrifugal force.

(iv) An electron can move only in those permissive orbits in which the angular momentum (mvr) of the electron is an integral multiple of $h/2\pi$. Thus, $mvr = n\frac{h}{2\pi}$ where m = mass of the electron, r = radius of the electronic orbit, v = velocity of the electron in it's orbit.

Answer to the question no : 3
(b)

The magnitude E of an electric field depends on the radial distance r according to $E = r\,4A$ where A is a constant with the unit volt-cubic meter. We can use the equation $E = K|Q|r 2E = K|Q|r_2$ to find the magnitude of the electric field. The direction of the electric field is determined by the sign of the charge which is negative in this case $E = KQr_2$.

The electric field formulla that gives its strength on the magnitude of electric field for a charge Q at distance r from the charge is $E = KQr_2$. where k is coulamb constant. and the units of the electric field are magnitude of the electric field is simply defined as the force per charge on the test charge. The standard metric units on electric field strength arise from its identi definition. The electric field between two depositely charged plates can be calculated : $E = V/d$. Devide the voltage on potential difference between the two plates by the distance between the plates. The SI units are V in volts (v), d in meters (m) and E in V/m. The work done in moving a charge 0.5 c through a distance 2 m along a direction making an angle 60° with x-axis is 10 J. Then the magnitude of electric field is ABC is a equilateral triangle.

Answer to the question number: 4

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The electrical potential difference between the two plates are expressed as V= Ed, the electric field strength times the distance between the plates. The units in this expression are newton/coulomb times meters, which gives the final units joulescoulomb. Since the voltage and plate separation are given, the electric field strength is known, the force on a charge is found using F= qEF =qE. The potential difference between points A and B, $\Delta V = V_B - V_A$. defined to be the change in potential energy of a charge q moved from A to B is equal to the ~~Charge~~ change in potential energy devided by the charge. Potential diffenence is commonly called voltage, represented by the symbol ΔV or often just V. electric Potential diffenence. also known as voltag is the external work needed to bring charge from one location to another loction in an electric field. Electrical

Potential difference is the best change of potential difference energy experienced by a test charge that has a value of +1. The equation $E = K|Q1/r2$ $E = K|Q|/r2$ says that, the electric field gets stronger as we approach the charge that generate it. For example:

at 2cm from the charge Q ($r = 2cm$) the electric field is four times stronger than at 4 cm from the charge ($r = 4cm$)