Iqra National University

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Q1:

a. How to calculate the magnetic force on current carrying wire?

Ans: The force on an individual charge moving at the drift velocity vd is given by $F = qvdB \sin \theta$. Taking B to be uniform over a length of wire l and zero elsewhere, the total magnetic force on the wire is then $F = (qvdB \sin \theta)(N)$, where N is the number of charge carriers in the section of wire of length

We can derive an expression for the magnetic force on a current by taking a sum of the magnetic forces on individual charges. (The forces add because they are in the same direction.) The force on an individual charge moving at the drift velocity vd is given by $F = qvdB \sin \theta$. Taking B to be uniform over a length of wire l and zero elsewhere, the total magnetic force on the wire is then $F = (qvdB \sin \theta)(N)$, where N is the number of charge carriers in the section of wire of length l. Now, $N = nV$, where n is the number of charge carriers per unit volume and V is the volume of wire in the field. Noting that $V = Al$, where A is the cross-sectional area of the wire, then the force on the wire is $F = (qvdB \sin \theta)(nAl)$. Gathering terms,

$F=(nqAvd)lB\sin\theta F=(nqAvd)lB\sin\theta$.

Because $nqAvd = I$ (see Current),

$F=IlB\sin\theta F=IlB\sin\theta$

is the equation for magnetic force on a length l of wire carrying a current I in a uniform magnetic field B, as shown in Figure 2. If we divide both sides of this expression by l, we find that the magnetic force per unit length of wire in a uniform field is $Fl=IB\sin\theta Fl=IB\sin\theta$. The direction of this force is given by RHR-1, with the thumb in the direction of the current I. Then, with the fingers in the direction of B, a perpendicular to the palm points in the direction of F, as in Figure 2.

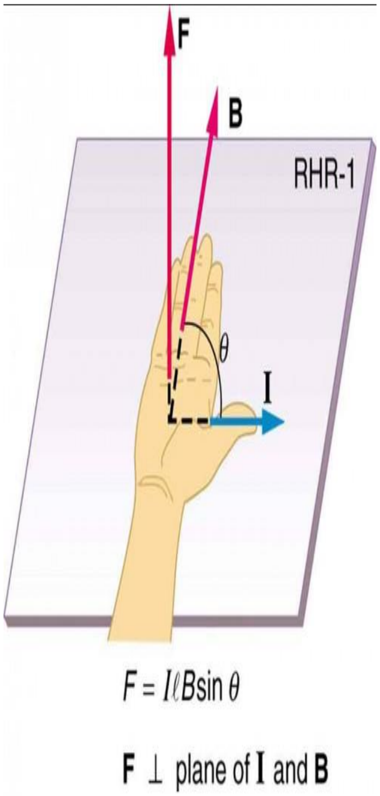


Figure 2. The force on a current-carrying wire in a magnetic field is F = IlB sin θ. Its direction is given by RHR-1.

b. What is the difference between Resistance and Resistivity?

Ans: Resistance is defined as the property of the conductor which opposes the flow of electric current. Resistivity is defined as the resistance offered by the material per unit length for unit cross-section. ... The SI unit of resistivity is Ohm

Resistance is defined as the property of the conductor which opposes the flow of electric current. It is also defined as the ratio of the voltage applied to the electric current flowing through it. The resistance of a conductor depends on the length, area of cross-section, and the nature of the material that is used in the manufacturing of the conductor. For a conductor, the resistance is directly proportional to the length of the conductor and inversely proportional to the area of cross-section.

Resistivity is defined as the resistance offered by the material per unit length for unit cross-section. The SI unit of resistivity is Ohm.meter. Resistivity increases linearly with temperature. The resistivity of conductors is low when compared to the resistivity of the insulators. Therefore, it can be represented as: Resistivity of conductors < Resistivity of alloys < Resistivity of insulators.

Q2:

a.What is the difference between reflection and refraction?

Ans: This phenomenon usually occurs in mirrors. This phenomenon usually occurs in Lenses. Reflection can simply be defined as the reflection of light when it strikes the medium on a plane. Refraction can be defined as the process of the shift of light when it passes through a medium leading to the bending of light.

There is a unique difference between Reflection and Refraction and it is important to analyze both these terms and understand the definitions of both these terms. Reflection is simply the property of a light that rebounds after hitting a surface. When the light that passes through a surface undergoes some changes in the appearance, whenever it usually passes through a medium, this phenomenon is usually referred to as Refraction. The two different types of lights that are typically involved in this are incident ray and the reflected ray. Light energy is incredible and has many uses to it.

b. Explain the difference among angle of incident, angle of reflection and angle of refraction with the help of formulae and a single diagram?

Ans: In optics, angle of incidence can be defined as the angle between a ray incident on a surface and the line perpendicular to the surface at the point of incidence (called as normal). To understand the angle of incidence, we have to first look into the concept of reflection of light. We all know that when a ray of light hits a polished surface like a mirror, it is reflected back.

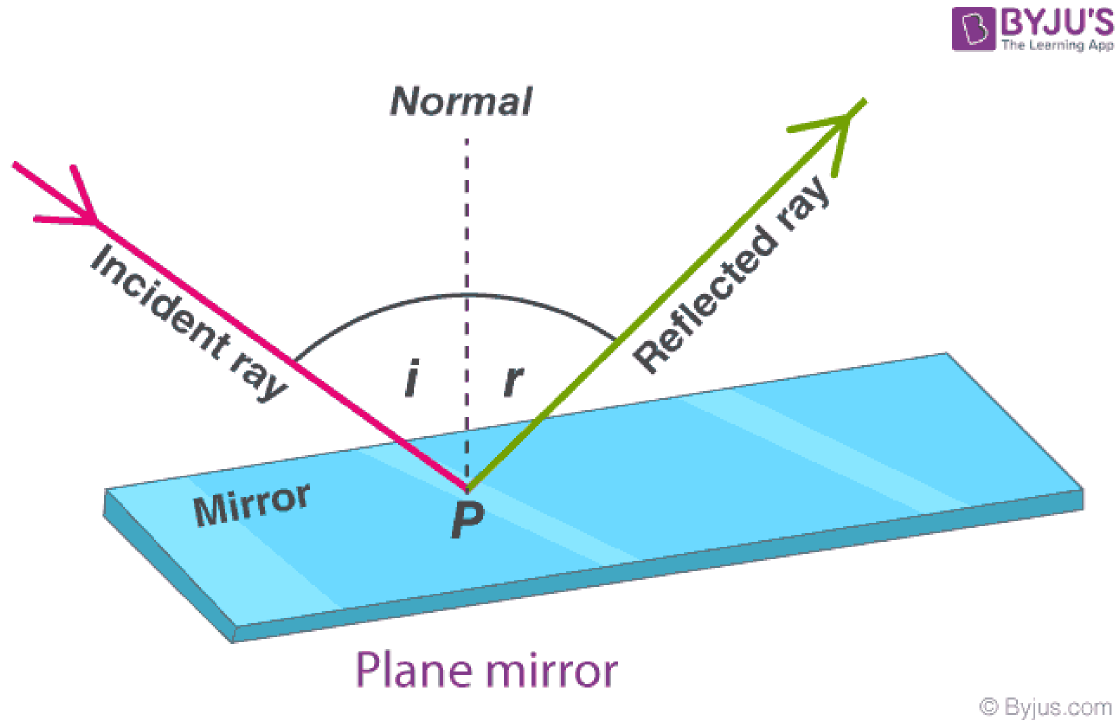
Here are some key points to make you understand the concept of angle of incidence easily.

The ray of light that hits the polished surface is called the incident ray.

The ray that gets reflected away is called the reflected ray.

The point at which the light hits the surface is called the point of incidence.

If a line is drawn perpendicular to that point, it is called the normal.



b. What is Angle of Incidence?

Ans: The incident ray and reflected ray form two angles at the point of incidence:

The angle formed between the normal and the incident ray at the point of incidence is called the angle of incidence.

Similarly, the angle formed between the normal and the reflected ray at the point of incidence is called the angle of reflection.

Angle Of Incidence Formula

The angle of incidence is equal to the reflected angle through the law of reflection. The angle of incidence and the angle of reflection is always equal, and they are both on the same plane along with the normal.

Q3:

a. Find the difference between electric potential energy and electric potential?

Ans: The basic difference between electric potential and electric potential energy is that Electric potential at a point in an electric field is the amount of work done to bring the unit positive charge from infinity to that point, while electric potential energy is the energy that is needed to move a charge against the electric field.

The gravitational potential at a point in the gravitational field is the gravitational potential energy of a unit mass placed at that point. In this way, the electric potential at any point in the electric field is the electric potential energy of a unit positive charge at that point.

If W is the work done in moving a unit positive charge q from infinity to a certain point in the field, the electric potential V at this point is given by:

$V = W/q$

It implies that electric potential is measured relative to some reference point and like potential energy we can measure only the change in potential between two points.

Electric potential is the scalar quantity. Its unit is volt which is equal to joule per coulomb (J/C).

See Also: Types of charges

Definition of volt

If one joule of work done against electric filed to bring the unit positive charge from infinity to the point in the electric field then potential difference at that point will be one volt.

Electric potential energy

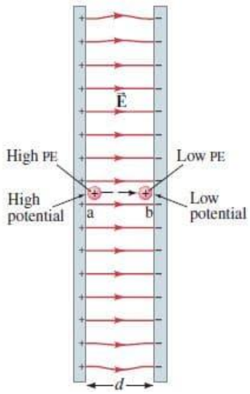
To apply the law of conservation of energy, we need to define electric potential energy, potential energy can be defined only for conservative force. The work done by a conservative force in moving an object between any two positions is independent of the path taken. The electrostatic force between any two charges is conservative because the dependence of on positions is just like the gravitational force which is a conservative force. Hence we can define potential energy for electrostatic force.

We know that the change in potential energy between any two points, a and b equals the negative of work done by the conservative force on an object as it moves from point a to point b:

Δ P.E = -W

Hence we define the change in potential energy (P.Eb – P.E a), when a point charge q moves from some point a to another point b.As the negative of the work done by the electric force on charge as it moves from point a to b.

For Example, consider the electric field between two equally but oppositely charged parallel plates, we assume their separation is small compared to their width and height, so the field E will be uniform over most of the region as shown in the figure:



Work is done by the the electric field in moving the positive charge from position a to position b.

Now consider tiny positive charge q placed at point “a” very near to the positive plate. This charge q is so small that it has no effect on electric field E.If this charge q at point a is released, the electric force will do work on the charge and accelerate it towards the negative plate. Work done by the electric field E to move the charge at a distance d is

How to find the potential difference between any two points in the electric field lines?

In a uniform electric field, the equation to calculate the electric potential difference is super easy: V = Ed. In this equation, V is the potential difference in volts, E is the electric field strength (in newtons per coulomb), and d is the distance between the two points (in meters).Apr 21, 2015

What is Electric Potential Difference?

The electric potential at a particular point in space is the work done in moving a positive charge from infinity to that point. The electric potential at infinity is defined as zero. It is related to the electric potential energy in that electric potential is the electric potential energy per unit charge.

So, if a four coulomb charge has 4,000 Joules of electric potential energy due to its position in an electric field, that would mean that the electric potential at that point in the field is 1,000 Joules per coulomb - each coulomb has a thousand Joules of electric potential energy. Whereas electric potential energy is specific to a particular charge, electric potential is defined only by a position inside a field. This makes it a much more useful quantity.

To understand how a point can have potential at all, think about dropping a mass in a gravitational field. If you drop a ball, it falls to the ground. This is because it had gravitational potential energy relative to the ground, and this energy was released when you let go of the ball. Gravitational potential (instead of electric potential) would be the energy per unit mass (instead of energy per unit charge), and would describe the point in space where you let go of the ball.

Let's imagine we have two parallel plates: one with a positive charge and one with a negative charge. In electromagnetism, we use a positive charge to define electric fields. So we'll focus on what happens to a positive charge inside the plates. If you release a positive charge on the negative plate, it won't go anywhere because opposites attract. But, if you release it on the positive plate, it will follow the field lines and 'fall' to the negative plate. So when we talk about electric fields, we say that the field lines point in the direction of decreasing electric potential.

And now, finally, that brings us to electric potential difference. Electric potential difference is the difference in electric potential between two points in space. That's really all it is. It is also measured in Joules per coulomb, but this is usually shortened to a different unit: volts. The electric potential difference between two sides of a battery is what makes electricity flow around a circuit. A 12V battery, for example, has a difference in potential of 12 Joules per coulomb on the two sides of the battery.

Uniform Electric Field

In a uniform electric field, the equation to calculate the electric potential difference is super easy: $V = Ed$. In this equation, V is the potential difference in volts (or Joules per coulomb), E is the electric field strength in the area (in newtons per coulomb), and d is the distance between the two plates (in meters).

The parallel plates situation I mentioned earlier is an example of a uniform electric field. Between the plates the field lines are equally spaced, so the field has the same strength everywhere - it's uniform. If we wanted to figure out the potential difference between the plates, we could take the electric field between the plates, E, and just multiply it by the distance between the plates. Strictly speaking, this distance, d, should always be in the direction of the field lines (if you move left and right on this diagram, the electric potential doesn't actually change at all)

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Q4:

a. Compare the depletion regions in forward bias and reverse bias?

Ans: The Forward bias decreases the resistance of the diode whereas the reversed bias increases the resistance of the diode. In forward biasing the current is easily flowing through the circuit whereas reverse bias does not allow the current to flow through it.

One of the major difference between the forward and the reverse biasing is that in forward biasing the positive terminal of the battery is connected to the p-type semiconductor material and the negative terminal is connected to the n-type semiconductor material. Whereas in reverse bias the n-type material is connected to the positive terminal of the supply and the p-type material is connected to the negative terminal of the battery. The forward and reverse biasing is differentiated below in the comparison chart.

Biasing means the electrical supply or potential difference is connected to the semiconductor device. The potential difference is of two types namely – forward bias and the reverse bias.

The forward bias reduces the potential barrier of the diode and establishes the easy path for the flow of current. While in reverse bias the potential difference increases the strength of the barrier which prevents the charge carrier to move across the junction. The reverse bias provides the high resistive path to the flow of current, and hence no current flows through the circuit

b. How reverse breakdown occur in a diode?

Ans: Avalanche breakdown in a diode occurs when we apply high reverse voltage across the diode which is higher than the zener break down voltage. Hence Avalanche breakdown in a diode occurs when reverse bias exceeds a certain value.

“Break down” of a diode occurs during its reverse biased condition. We all know, under reverse bias the positive terminal of battery is connected to n side and the negative terminal of battery is connected to p side.

Q5:

a. Explain the Magnetic field of solenoids?

Ans: A solenoid is a long coil of wire wrapped in many turns. When a current passes through it, it creates a nearly uniform magnetic field inside. The magnetic field within a solenoid depends upon the current and density of turns. ...

A solenoid is a long coil of wire wrapped in many turns. When a current passes through it, it creates a nearly uniform magnetic field inside.

Solenoids can convert electric current to mechanical action, and so are very commonly used as switches.

The magnetic field within a solenoid depends upon the current and density of turns.

In order to estimate roughly the force with which a solenoid pulls on ferromagnetic rods placed near it, one can use the change in magnetic field energy as the rod is inserted into the solenoid. The force is roughly

change in magnetic field energy

force on rod = -------------------------------

distance rod moves into solenoid

The energy density of the magnetic field depends on the strength of the field, squared, and also upon the magnetic permeability of the material it fills. Iron has a much, much larger permeability than a vacuum.

Even small solenoids can exert forces of a few newtons.

b. Explain the Magnetic field of Toroids?

Ans: All of the loops of wire which make up a toroid contribute magnetic field in the same direction inside the toroid. The sense of the magnetic field is that given by the right hand rule, and a more detailed visualization of the field of each loop can be obtained by examining the field of a single current loop.

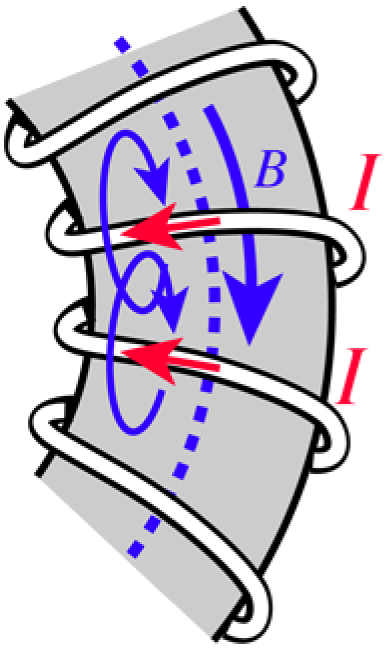
Finding the magnetic field inside a toroid is a good example of the power of Ampere's law. The current enclosed by the dashed line is just the number of loops times the current in each loop. Amperes law then gives the magnetic field by

$$B 2\pi r = \mu N I$$

$$B = \frac{\mu N I}{2\pi r}$$

The toroid is a useful device used in everything from tape heads to tokamaks.

Toroid Detail



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