Ever wondered why magnets attract some materials or how electric current can create a magnetic field? That is exactly what you will learn in Class 10 Science Chapter 12: Magnetic Effects of Electric Current. This chapter explains how electricity and magnetism are connected and it is very useful for understanding everyday devices like electric bells, motors, generators and circuit breakers. This is also a very important chapter for CBSE board exams and science competitions like NSO and NSEJS etc. These NCERT Notes for Class 10 Science are made by expert faculty of Careers360 as per the latest CBSE syllabus. These NCERT notes for class 10 include important topics such as magnetic field and field lines, the magnetic field due to a current-carrying wire, the right-hand thumb rule, electromagnets, and domestic electric circuits. These NCERT Notes also include clear diagrams and real-life applications to make your learning simple and effective. Whether you are studying for school or preparing for exams, these notes will make the concepts easy to grasp.Magnetic Effects of Electric Current Class 10 Notes: Download PDFNCERT Class 10 Science Chapter 12 NotesClass 10 Chapter Wise NotesAlso Read Magnetic Effects of Electric Current Class 10 Notes: Download PDFDownload PDFNCERT Class 10 Science Chapter 12 NotesMagnetic FieldA magnetic field is the area around a magnet where any other magnetic element can feel its influence.(i) The SI unit of magnetic field intensity is tesla (T) or Weber per square metre ($\mathrm{Wb} \mathrm{m}^{-2}$). (ii) The CGS unit of magnetic field intensity is gauss (G) [1 $\mathrm{T}=10^4$ gauss]. (iii) Magnetic field is a vector quantity, because its complete specification needs both direction as well as magnitude.Magnetic Field LinesMagnetic field lines represents the magnetic field, it is path either straight or curved, the tangent to which at any point gives the direction of the magnetic field at that point.Properties of Magnetic Field Lines (i) There are always closed loops. (ii) The lines point from north pole to south pole outside the magnet and from south pole to north pole inside it. (iii) The magnetic field lines never cross each other. If they do so, then at the point of intersection there will be two tangents which give two directions of magnetic field at the same point which is not possible. (iv) The density of the lines is proportional to the strength of the magnetic field. (v) In the region of stronger field the lines converge and in the region of weaker field the lines diverge.Magnetic Field Due to a Current-Carrying ConductorWhen electric current flows through a conductor (like a wire), it creates a magnetic field around it. This was first discovered by Hans Christian Oersted.The direction of the magnetic field depends on the direction of the current. The Right-Hand Thumb Rule helps to find this direction.Magnetic Field Due to a Current through a Straight ConductorThe magnetic field lines around a straight conductor carrying current are concentric circles on planes perpendicular to the direction of current. The direction of magnetic field due to straight current carrying wire can be obtained by 'Right Hand Thumb Rule'.Right-hand thumb rule :Imagine yourself grasping a current-carrying conductor with your right-hand, so that the thumb lies along the conductor in the direction of the current, then the fingers of your hand will be encircling the conductor in the direction of the magnetic field lines caused by the current.Magnetic Field Due to a Current through a Circular LoopThe magnetic field lines around a circular current carrying wire are as shown in the figure below. Every point on the wire carrying current would give rise to the magnetic field appearing as straight lines at the center of the loop.Magnetic Field Due to a Current in a Solenoid(a) A solenoid is a long cylindrical coil containing a large number of closely spaced turns of insulated copper wire. (b) The magnetic field produced by a current carrying solenoid is similar to the magnetic field produced by a bar magnet.ElectromagnetIf a core of ferromagnetic material, such as soft iron, is placed inside a solenoid, the magnetic field strength inside the solenoid is greatly increased. Because of the permeability of the iron, the field lines within the solenoid crowd into the iron core. This has two effects. First, the crowding concentrates the field lines due the solenoid; the closer together the field lines, stronger is the field. Second, the field lines due to the solenoid induce a magnetism inside the iron core, so that the ferromagnetic material becomes a magnet whose field supplements the field of the solenoid. Electromagnets are widely used as components of electrical devices such as motors, generator, electric bell etc.Force on a Current-Carrying Conductor in a Magnetic FieldWhen a current-carrying conductor is placed in a magnetic field, it experiences a force. This is the principle behind electric motors and many other electromagnetic devices.Fleming's left hand ruleIf the forefinger, the second finger and the thumb of the left hand are stretched at right angles to each other, with the forefinger pointing in the direction of the field and the second finger in the direction of the current then the thumb indicates the direction of the force. It is called Fleming's left hand rule.Domestic Electric CircuitsA domestic electric circuit is the wiring system used in homes to supply electricity to various appliances. It connects electrical devices like fans, lights, refrigerators, and TVs to the main power supply safely and efficiently.Class 10 Chapter Wise NotesNCERT Solutions of Class 10 Subject WiseNCERT Solutions for Class 10 MathsNCERT Solutions for Class 10 ScienceNCERT Class 10 Exemplar Solutions for Other Subjects: NCERT Books for Class 10NCERT Syllabus for Class 10 Made with lots of love and caffeine since 2014 2025, Teachoo. All rights reserved. Magnetism in Physics is defined as the property of the material that is responsible for the magnetic behaviour of the magnets. Magnetism is defined as the force that is produced by the moving charge and it attracts or repels other magnets and magnetic materials. Initially, magnetism is defined as the property of some material to attract or repel some other magnets. Later it was discovered that all the moving charges are considered to be magnets and their property of attraction or repulsion is called magnetism. Here, in this article, we will learn about, Magnetism Definition, History of Magnets, Causes of Magnetism, Magnetic Materials, Properties of Magnets and others in detail. What is Magnetism?Magnetism is a phenomenon induced by the force exerted by magnets, which produces fields that attract or repel other metallic objects. It occurs as a result of electrically charged particles. A magnetic field exerts a force on other metallic objects such as the Lorentz force this force depends on the strength of the magnetic field and the velocity of the charged particle. For any magnets, Like poles repel each other.Opposite poles attract each other.Magnetism DefinitionMagnetism in general is defined as the phenomenon associated with the magnetic fields. We know that magnetic fields are produced by moving electric charges and thus magnetism is the property of the moving charged particle that produces a force that is exerted on the other metallic material inside the magnetic field of the moving charge. History Of MagnetismEverything around us is made up of electrons and they are continuously moving. So one might ask why everything around us is not a magnet including ourselves. The answer to this is, that individual electrons moving around any object behave as a magnet but overall all these small magnets cancel out each other's magnetic property and thus not all material behaves as a magnet. In some materials, all the electrons are arranged in such a way that they do not cancel each other and they are called ferromagnetic material. These ferromagnetic materials are called permanent magnets as they attract other metallic materials naturally. The property of magnetism is first observed in a material called Magnetite (Fe3O4) hence the name magnets. These magnets is scattered all around the Earth's crust and was first noticed by a shepherd in Greece. Magnetism PropertiesThe various properties of the magnets are, Attractive Property: Magnets attracts other ferromagnetic and paramagnetic substances. Repulsive Property: Like poles of a magnets always repel each other. Magnetism of EarthEarth have a magnetic field and this is observed whenever we pin a compass it always arranged in the north south direction this is because of the Earth magnetism. Geographical North Pole of the Earth is the magnetic South Pole of the Earth and geographical South pole of the Earth is the magnetic North pole of the Earth. What is Magnetic Field?Magnetic field or magnetism field is defined as the space or region around a magnet in which magnetic force is applied to another metallic material. The magnetic field or magnetism can be represented in a variety of ways. It may be represented mathematically as a vector field that can be displayed as various sets on a grid. Another method is to utilize field lines. Magnetic field lines never cross each other. The denser the magnetism field lines the more strength of the magnetic field they represent. The magnetic field of the bar magnet is shown in the image added below. Unit of Magnetic Field Magnetic field is measured by determining the intensity and direction of the magnetic field. The measurement is required because each magnetic field differs from the others. In a magnetic field, we measure two things that are, Magnetic Field Strength(H) is measured in Ampere/meter. Magnetic Flux Density(B) measured in Tesla.Magnetic Field LinesMagnetic field lines are a type of visual representation of magnetic fields. They describe the magnetic force direction and magnetic force strength at any particular point near the magnet. The magnitude of the field is indicated by the density of the lines. For example, at the poles of a magnet, the magnetic field is stronger and denser. It becomes weaker as we go away from the poles, and the lines become less dense. Magnetic Field Line PropertiesThere are various properties of the magnetic field lines and some of them are, Magnetic field lines never cross each other.Magnetic field lines are always closed loops. The density of the field lines reflects the field's intensity.Magnetic field lines always arise from or begin at the north pole and end at the south pole.Magnetic MaterialsAll the materials around us can be categorized into three types and they are, Diamagnetic MaterialsParamagnetic MaterialFerromagnetic MaterialsDiamagnetic Material: In general most of the materials around us have diamagnetism. In this material, they have paid electrons and thus they have no magnetic property. Examples of Diamagnetic Materials are Copper, Gold, Silver, etc. Paramagnetic Materials: The materials that have unpaired electrons are called paramagnetic materials and they show paramagnetism, i.e. they experience some force inside the magnetic field of other magnets. The dipole magnetic moment of the electrons does not align in the case of the paramagnetic materials. Examples of Paramagnetic Materials are Magnesium, Lithium, etc. Ferromagnetic Materials: There are very few materials that have ferromagnetism and they can be made permanent magnets. In ferromagnetic materials they have unpaired electrons and their magnetic moment is free to align itself freely. Examples of Ferromagnetic materials are, Iron, Cobalt, and Nickel. Magnetism TypesThere are five types of magnetism that are, DiamagnetismParamagnetismFerromagnetismAnti-FerromagnetismFerrimagnetismDiamagnetismDiamagnetism is the property of the Diamagnetic Materials. These materials have paired electrons and they do not experience force in magnetic field. In a diamagnetic substance there are no permanent magnetic dipole moment of the electrons. ParamagnetismParamagnetism is the property of the material that have unpaired of the electrons. These material are called the paramagnetic material. Here in these material the magnetic moment of the electrons and they tends to be arranged randomly such that there overall magnetic moment cancel out each other. FerromagnetismMagnetism of the ferromagnetic material is called the ferromagnetism. These materials have the tendency to arrange themselves in the influence of an external magnetic field and thus increase magnetic moment of the material. Anti-FerromagnetismAnti-ferromagnetism is the property of the material in which the individual magnetic moment of the material arranges itself such that its magnetic moment is same with its adjacent one but the direction is opposite, which cancels the overall magnetism of the material. FerrimagnetismFerrimagnetism is the property of the material in which the adjacent magnetic moment of the electrons are opposite to each other and their magnitude is not the same. thus, the material shows the overall magnetism and experiences some force in the external magnetic field. Magnetic ForceThe magnetic force is the attraction or repulsion force that exists between electrically charged particles as a result of their motion. The magnetic force between two moving charges is defined as the force imposed on one's charge by the magnetic field generated by the other. This force is responsible for magnets attracting or repelling one another. A compass, a motor, the magnets that keep things on the refrigerator, railway lines, and new roller coasters are all examples of magnetic force. A magnetic field is created by all moving charges, and the charges that travel across its areas experience a force. Depending on whether the force is attractive or repulsive, it might be positive or negative. The magnetic force on an item is determined by its charge, velocity, and magnetic field. Force on Moving ChargeA charge experiences a force if it travels across a magnetic field. The force on a moving charge in a magnetic field is given by the formula, F = q v.B.sin where, q is the ChargeB is the Magnetic Fieldv is the Velocity of the Charge is the Angle Between Magnetic Field and Velocity of ChargeMagnetic Effect Of CurrentMoving charge produces electric field and this shown in the experiment added below: In the above material if the current pass through the copper wire then it deflects the compass placed near it. This shows that moving charges produces electric field. Right-Hand RuleThe right-hand Rule is used to determine the direction of the force (F) in a magnetic field. Right-Hand Rule states that, Point your pointer finger towards the direction of the charge's motion. Between v and B, rotate your middle finger away from your index finger. Hold your thumb parallel to the plane produced by your index and middle fingers. If the charge q is positive, your thumb will point in the direction of force (F). The image added below shows the Right Hand Rule. Uses of MagnetsVarious uses of the magnets are, Magnets is used in magnetic compass to gets the direction.Magnets are used in Speakers and others.Magnets are used in Electric Motors and Electric Dynamos.Electromagnets are used in Magler Trains and others.Magnets are used in construction industries.One of the most important use of Magnetism is, Magnetism Separation of various objects. Magnetism Separation MethodMagnetism Separation is a process of separating various metallic impurities and other thing form the ore, or separating metallic ore from the non-metallic impurities. Eg. Iron metal is separated from impurities by magnetism separation method. Read More, Magnetic Force on a Current-Carrying WireMagnetic Field StrengthLenzs LawExample on Magnetic Force FormulaExample 1: Find magnetic force on a charged particle travelling at 5 m/s in a magnetic field of 2 T? Its field's direction is the same as the route of the charged particle. (Given q = 40 C) Solution: Given: Charge, q = 40 CVelocity, v = 5 m sMagnetic Field, B = 2 TBecause the second route difference is the same as the direction of its field, = 30 F= q V B sin F = 40 5 2 sin 0 F = 0 Hence, the magnetic force of charged particles is 0 N. Example 2: Find the particle force on a charged particles travelling at (v) 20 m/s in a magnetic field of (B) 10 T? If the angle between q and B is 30 (Given q = 4 C) Solution: Given: Charge, q = 4 CVelocity, v = 20 m sMagnetic Field, B = 10T = 30F= q V B sin F = 4 20 10 sin 30 F = 400 N Hence, the magnetic force of charged particles is 400 N. Know about Physics WallahPhysics Wallah is an Indian edtech platform that provides accessible & comprehensive learning experiences to students from Class 6th to postgraduate level. We also provide extensive NCERT solutions, sample paper, NEET, JEE Mains, BITSAT previous year papers & more such resources to students. Physics Wallah also caters to over 3.5 million registered students and over 78 lakh+ Youtube subscribers with 4.8 rating on its app.We Stand Out because We provide students with intensive courses with Indias qualified & experienced faculties & mentors. PW strives to make the learning experience comprehensive and accessible for students of all sections of society. We believe in empowering every single student who couldn't dream of a good career in engineering and medical field earlier.Our Key Focus AreasPhysics Wallah's main focus is to make the learning experience as economical as possible for all students. With our affordable courses like Lakshya, Udaan and Arjuna and many others, we have been able to provide a platform for lakhs of aspirants. From providing Chemistry, Maths, Physics formula to giving e-books of eminent authors like RD Sharma, RS Aggarwal and Lakhmir Singh, PW focuses on every single student's need for preparation.What Makes Us DifferentPhysics Wallah strives to develop a comprehensive pedagogical structure for students, where they get a state-of-the-art learning experience with study material and resources. Apart from catering students preparing for JEE Mains and NEET, PW also provides study material for each state board like Uttar Pradesh, Bihar, and othersYou are here:Home page Want to know why giant ships can float, how your earbuds make music, what graphene is, or how windows can clean themselves? You've come to the right place! Here you'll find simple explanations you can really understandhurrah! Hard stuff... made simple! Explain that Stuff is an online book written by science writer Chris Woodford(author of many popular science books for adults and children). It includes over 400 easy-to-understand articles, richly illustrated with over 4000 photos, artworks, and animations, covering how things work, cutting-edge science, cool gadgets, and computers. We take the "pain" from explain and the "tough" out of stuff! There's more information on this website than in your average expensive science book, it's continually updated, and it's completely free to use! Explain that Stuff also helps to support curriculum learning (conventional STEM education and home-schooling). How to use this site There are five simple ways to find what you want: What's not in June 2025? Our simple introductions explain the science behind the headlines in the news now... Heat pumpsThe British government is changing planning laws to encourage takeup of heat pumpssuper-efficientmachines that can warm your home using heat from outdoors, even on cold days.[News story]Photonic (laser-light-powered) microchips have been touted as an alternative to pure electronics. Two newly released studies could be a bright sign for the future of computing.[News story]GeoengineeringHow could we intervene to slow the collapse of glaciers in our ever-warming world? Glacial engineering is the new geoengineering! [News story]Climate changeNASA and the World Meterological Organization have confirmed 2024 as the hottest year on record,and the first with a global mean temperature over 1.5C the 18501900 average.[News story].MaterialsA recent report in The New York Times reminds us how all the "stuff" humans have madein the last century (plastics, concrete, and other things) weighs more than all the living things on the planet. A fascinating new visualization compares the two things, side by side.[News story]Space rocketsIndia's heading for another space firstit's first ever test of a space rocket "docking" mission. What exactly are rockets and how do they work?[News story]Quantum computingGoogle has unveiled Willow, a new quantum computing chip that's much better at error correction.Critics wary of quantum hype say it's more of a "milestone" than a "breakthrough."[News story]Lithium-ion batteries A proposed new lithium mine in Serbia that supplies the raw materials for electric car batteries has become a focal point for eco protests.[News story] What's new? Some of our newest and most recently updated articles... Electric carsAre they as good as the hype? Are they as clean and green as people claim? Why are they taking so long to catch on?Artificial intelligenceCan we imagine a world where computers are smart enough not to need us? Is "human intelligence" agood starting point for designing useful machines?GravityIt's taken over three millenia for people to understand how gravity holds the universe together. What do we know so far about this most mysterious of forces?History of flightPlanes can trace their history back thousands of years to ancient myths and legends. Why has humans always dreamed of soaring to the sky... and why did it take us so long?CranesThe science behind cranes is easy to understand, but why are there so many different types? How much can theylift... and what stops them toppling over?History of electricityElectricity is an ancient science that powers our modern world. Why did it take us so long to figure out how it works and put it to practical use? Find out in our sparkly story of electric power!SoftwareComputers are wonderful machines you can reprogram to do almost anything. Learn more about algorithms, computerlanguages, and the basic principles of coding in our simple guide.Great psychology experimentsIt's no big surprise that other people aren't quite like us, but the astonishing finding from modern psychology is that even our own minds are strange and complex things we don't fully understand.What is scienceand why does it matter?From atoms and cells to nuclear power plants and the human brain, the scope of scienceis truly amazing. But what exactly is the scientific method... and why is it still our best hope for making sense of the world? History of communicationHow did we get from the alphabet to the Internet in a few thousand years? Follow thestory of shared information from cuneiform and hieroglyphs, through radio and TV, to streaming mediaand the Web. Most popular These are some more of our classic, ever-popular articles: Water pollutionRivers and seas take a long time to recover from the effects of careless human treatment. What causes pollution and what can we do to stop it?ElectricityThe most versatile and useful form of energy in our world, electricity is going to become a whole lot more important in future. NanotechnologyCan we build a brave new world just by shuffling atoms and molecules under a microscope?MagnetismOne of the first bits of science people studied, magnetism is still just as relevant today in everything from electric cars to body scans at the hospital.GearsWheels with teeth carved around them can make you go faster or bump up your powerand here's how.BatteriesWe all need electricity, wherever we happen to be, so thank goodness for batteriesminiature power plants you can carry in your pocket! Electric motorsThese amazing machines turn electricity and magnetism into movement, powering everything from handheld toothbrushes to bikes, cars, and trains.Global warmingClimate scientists recently issued their strongest ever warning about the growing risks of irreversible "global warming." If you find the subject baffling, try our easy-to-follow introduction.Cloud computingWhy buy yourself an expensive computer or programs to go with it when you can get access to something just as good over the Internet? What are the benefits and drawbacks of working in "the cloud"? What else is on our site? The articles on our site are divided up into broad topical areas, listed below. We've also given you a rough idea of the kind of questions you're going to find answers to in each section: CommunicationsWhy do we bounce telephone calls off satellites? How do cellphones work? What's the difference between digital radio and ordinary radio?ComputersHow can you make a computer think like a human brain? Who invented the computerand why are the "electric" and "electronic"? How can you make coffee with a stream of electrons? How are magnets helping to make cars? and how is electricity generated? How does wind energy come from the Sun? Is nuclear power safe or not? Will the world ever run out of energy? Why are we still so dependent on "fossil fuels"?EngineeringWhat stops a bridge falling over? Why can a person lift more stuff with a crane than with their bare hands? What's the difference between hydraulics and pneumatics?EnvironmentCan we still stop dangerous climate change? What causes air and water pollution and how can the world clean up its act? Is organic food really "better"and if so, why?GadgetsHow does a flash memory card store your holiday snaps? Why can a synthesizer mimic any musical instrument that's ever been invented (and even ones that haven't been)?Home lifeHow can you make windows turn dark at the flick of a switch? If an energy-saving lamp saves energy, how come it still makes exactly the same amount of light?MaterialsIf you had a piece of platinum as big as a man, how much would it be worth? Why doesn't a dry-stone wall fall over? Is it true that glass is a kind of liquid?ScienceWhich part of a candle flame is the hottest? Why does chocolate actually taste good? Where's the best place to sit on a rollercoaster if you want to scare yourself to death?TransportationIf a man can't fly, how can a plane fly if it weighs as much as 5000 men? How come we say a wheel reduces friction if it's tyre grips the road? Why do huge ships float when even tiny bits of metal sink? Who uses this site? In the 19 years since our site went online (20062025), pages from this site have been viewed over 140 million times in total. Our articles have been cited by dozens of books and over 2000 academic papers and patents. We've received over 4000 user feedback forms in the last decade and 92% gave us four or five stars (a weighted average of 4.6but there's always plenty of room to do better. We hope you find this site useful too! Follow us on your favorite sites! Now you've found us, don't lose us.Why not join our friendly Facebook page, where we post cool science and technology news? You'll find our photos on Flickr and we're also on Pinterest. In 2024 and 2025, we recorded a 50-episode podcast with audio versions of some of our articles.Although it's currently on hiatus, you can still listen to the old episodes by subscribing to our podcast feed in Apple Podcasts, Spotify, or your favorite player.Our podcast is free (and because we host it on our own server) completely ad free! Tell your friends If you've enjoyed this website, please kindly tell your friends about it or link to us on yourfavorite social sites. Press CTRL + D to bookmark this page for later, or email the link to a friend. Privacy and cookies Our website serves advertisements to pay its running costs. 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Home Practice For learners and parents For teachers and schools Past papers Textbooks Mathematics Mathematics Grade 7 Mathematics Grade 8 Mathematics Grade 9 Mathematics Grade 10 Mathematics Grade 11 Mathematics Grade 12 Mathematical Literacy Mathematical Literacy Grade 10 Physical Sciences Physical Sciences Grade 10 Physical Sciences Grade 11 Physical Sciences Grade 12 Natural Sciences Natural Sciences Grade 4 Natural Sciences Grade 5 Natural Sciences Grade 6 Natural Sciences Grade 7 Natural Sciences Grade 8 Natural Sciences Grade 9 Life Sciences CAT CAT Grade 10 CAT Grade 11 CAT Grade 12 IT IT Grade 10 IT Grade 11 IT Grade 12 Full catalogue Leaderboards Learners Leaderboard Grades Leaderboard Schools Leaderboard Campaigns Learner opportunities Pricing Support Log in Yes, I reside in South Africa Change country/curriculum by Chris Woodford. Last updated: September 14, 2023. Science is our understanding of how the world works and generally the world works fine whether we understand it or not. Take magnetism, for example. People have known about magnets for thousands of years and they've been using them practically, as compasses, for almost as long.The ancient Greeks and Romans knew as well as we do that lodestone (an iron-rich mineral) can attract other pieces of iron, while the ancient Chinese were making magnetic compasses set in intricate wooden inlays for their practice of Feng Shui (the art of carefully arranging a room) thousands of years before interior designers came on board. Science can sometimes be slow to catch up: we've only really learned how magnetism works in the last century, since the world inside atoms was first discovered and explored.Photo: This powerful "horn" uses a massive electric current (200,000 amps) to create a very strong magnetic field. A bit like a lens, it can focus subatomic particles called neutrinos into powerful beams as part of experiments in the Fermilab particle accelerator. Photo by courtesy of US Department of Energy (Flickr). Contents Playing with magnets is one of the first bits of science most children discover. That's because magnets are so easy to use, and fun. They're also quite surprising. Remember when you first discovered that two magnets could snap together and stick like glue?Remember the force when you held two magnets close and felt them either attract (pull toward one another) or repel (push away)? One of the most amazing things about magnets is the way they can attract other magnets (or other magnetic materials) "at a distance," invisibly, through what we call a magnetic field. Photo: The magnetic field between the opposite poles of two bar magnets that strongly attract one another. We can't normally see magnetic fields, but if you sprinkle iron filings (tiny bits shaved off an iron bar with a file) onto a piece of paper and hold it above the magnets you can see the field underneath. Photo by courtesy of Wikimedia Commons (where you'll find a bigger version of this image). To ancient people, magnetism must have seemed like magic. Thousands of years down the line, we understand what happens through magnetic materials, how their atomic structure causes their magnetic properties, and how electricity and magnetism are really just two sides of the same coin: electromagnetism. Los Alamos National Laboratory has vested magnetism as the strange, invisible force of attraction between certain materials; today, we're more likely to define it as a force created by electric currents (themselves caused by moving electrons). Photo: A colorful way to visualize invisible magnetic fields using a computer graphics program developed at Los Alamos National Laboratory. In this three-dimensional chart, the height and color of the peaks shows the strength of the magnetic field at each point. Photo by courtesy of US Department of Energy. Suppose you put a bar magnet (shaped like a rectangle, sometimes with the north and south poles painted different colors) or a horseshoe magnet (bent round into a tight U-shape) onto a table and place an iron nail nearby. If you push the magnet slowly toward the nail, there will come a point when the nail jumps across and sticks to the magnet. That's what we mean by magnets having an invisible magnetic field that extends all around them. Another way of describing this is to say that a magnet can "act at a distance": it can cause a pushing or pulling force on another object it isn't actually touching). Magnetic fields can penetrate through all kinds of materials, not just air. You probably have little notes stuck to the door of your refrigerator with brightly colored magnets so you can see that magnetic fields cut through paper. You may have done the trick where you use a magnetic pick up a long chain of paperclips, with each clip magnetizing the next one along. That little experiment tells us that a magnetic field can penetrate through magnetic materials such as iron. The strength of the field around a magnet depends on how close you get: it's strongest very near the magnet and falls off quickly as you move away. (That's why a small magnet on your table has to be quite close to things to attract them.) We measure the strength of magnetic fields in units called gauss and tesla (the modern SI unit, named for electricity pioneer Nikola Tesla, 18561943). It's interesting to note that the strength of Earth's magnetic field is very weak about 1001000 times weaker than that of a typical bar or fridge magnet. On earth, gravity, not magnetism, is the force that sticks you to the floor. We'd notice Earth's magnetism much more if its gravity weren't so very strong. Comparing magnetism To get a real sense of everyday magnetism, take a look at this chart. Please note that the vertical scale is logarithmic: each step up the scale means the strength of the magnetic field has increased ten times: Chart: Comparing the strength of some "everyday" sources of magnetism. Sources: [1] The main thing to note here is how weak Earth's magnetism is (the green block on the extreme left) compared to everything else we routinely encounter (never mind the giant magnets used in hospitals and labs). The record-breaking lab magnetic field shown on the extreme right, created in Japan in April 2018, is about 24 million times stronger than Earth's magnetic field. Almost everything produces magnetism even our own bodies, which have something like a puny 0.000000001 tesla. What is an electromagnet? The Homer Simpson or Mickey Mouse magnet that holds things to your refrigerator is a permanent magnet: it keeps hold of its magnetism all the time. Not all magnets work this way. You can make a temporary magnet by passing electricity through a coil of wire wrapped around an iron nail (a device you'll sometimes see referred to as a solenoid). Switch on the current and the nail becomes a magnet; switch it off again and the magnetism disappears.(This is the basic idea behind an electric chime doorbell: you make an electromagnet when you press the button, which pulls a hammer onto the chime barding-dong!)Temporary magnets like this are called electromagnets magnets worked by electricity and they hint at a deeper connection between electricity and magnetism that we'll come on to in a moment. Photo: Scrapyards sometimes use giant electromagnets to heave metal from place to place (though some use grabber claws instead). Photo by Marjory Collins, U.S. Farm Security Administration/Office of War Information, courtesy of US Library of Congress. Like permanent magnets, temporary electromagnets come in different sizes and strengths. You can make an electromagnet powerful enough to pick up paperclips with a simple 1.5-volt battery. Use a much bigger voltage to make a bigger electric current and you can build an electromagnet powerful enough to pick up a car. That's how scrapyard electromagnets work. The strength of an electromagnet depends on two things: the size of the electric current you use and the number of times you coil the wire. Increase either or both of these and you get a more powerful electromagnet. Maybe you think magnets are interesting; maybe you think they're boring! Whatever they are, you might ask, apart from in childish magic tricks and scrapyards? You might be surprised just how many things around you work by magnetism or electromagnetism. Every electric appliance with an electric motor in it (everything from your electric toothbrush to your lawn mower) uses magnets to turn electricity into motion.Motors use electricity to generate temporary magnetism in wire coils. The magnetic field thus produced pushes against the fixed field of a permanent magnet, spinning the inside part of the motor around at high speed. You can harness this spinning motion to drive all kinds of machines. Photo: A typical fridge door magnet holds tight to your refrigerator holding the door closed. Magnets read and write data (digital information) on your computer's hard drive and on cassette tapes in old-fashioned personal stereos. More magnets in your hi-fi loudspeakers or headphones help to turn stored music back into sounds you can hear. If you're sick with a serious internal illness, you might have a type of body scan called NMR (nuclear magnetic resonance), which draws the power behind your skin using patterns of magnetic fields. Magnets are used to recycle your metal trash (steel food cans are strongly magnetic but aluminum drinks cansare not, so a magnet is an easy way to separate the two different metals). Photo: An MRI scan like this builds up a detailed image of a patient's body (or, in this case, their head) on a computer screen using the magnetic activity of atoms in their body. You can see the patient in the white scanner at the top right and the scanned image of their body on the screen below. Photo by Seth Rossman courtesy of US Navy and Wikimedia Commons. Which materials are magnetic?Iron is the king of magnetic materials the metal we think of magnets. Most other common metals (such as copper, gold, silver, and aluminum) are, at first sight, nonmagnetic and most nonmetals (including paper, wood, plastic, concrete, glass and textiles such as cotton and wool) are nonmagnetic too. But iron's not the only magnetic metal. Nickel, cobalt, and elements that belong to a part of the Periodic Table (the orderly arrangement chemists use to describe all the known chemical elements) known as the rare-Earth metals (notably samarium and neodymium) also make good magnets. Some of the best magnets are alloys (mixtures) of these elements with one another and with other elements. Ferrites (compounds made of iron, oxygen, and other elements) also make superb magnets. Lodestone (which is also called magnetite) is an example of a ferrite that's commonly found inside Earth (it has the chemical formula FeOFe2O3). Photo: A typical horseshoe magnet. See the trace of brown rust on the top of the magnet's upper "leg"? That happens because the magnet is made of iron, which corrodes (rusts) in damp air. Materials like iron turn into good temporary magnets when you put a magnet near them, but tend to lose some or all of their magnetism when you take the magnet away again. We say these materials are magnetically soft.By contrast, alloys of iron and the rare-Earth metals retain most of their magnetism even when you remove them from a magnetic field, so they make good permanent magnets. We call those materials magnetically hard.It is true to say that all materials are either magnetic or nonmagnetic? People used to think that but scientists now know that materials we consider to be nonmagnetic are also affected by magnetism, though extremely weakly. The extent to which a material can be magnetized is called its susceptibility.How different materials react to magnetism Scientists have a number of different words to describe how materials behave when you put them inside a magnetic field. Broadly speaking, we can divide all materials into two kinds called paramagnetic and diamagnetic, while some of the paramagnetic materials are also ferromagnetic. It's important to be clear what these confusing words actually mean... ParamagneticMake a sample of a material magnetic and hang it from a thread so it dangles in a magnetic field, and it will turn and line itself up so its magnetism is parallel to the field. As people have known for thousands of years, this is how exactly a compass needle behaves in Earth's magnetic field. Materials that behave this way are called paramagnetic. Materials such as aluminum and almost nonmetals (which you might think aren't magnetic at all) are actually paramagnetic, but so weakly that we don't notice the effect. Paramagnetism depends on temperature: the hotter a material is, the less it's likely to be affected by nearby magnets.Photo: We think of aluminum (used in drinks cans like these) as nonmagnetic. That helps us to separate for recycling our aluminum cans (which don't stick to magnets) from our steel ones (which do). In fact, both materials are magnetic. The difference is that aluminum is very weakly paramagnetic, while steel is strongly ferromagnetic. Photo courtesy of US Air Force. FerromagneticSome paramagnetic materials, notably iron and the rare-Earth metals, become strongly magnetized in a field and usually stay magnetized even when the field is removed. We say materials like this are ferromagnetic (they're "magnetic like iron." However, a ferromagnetic material will still lose its magnetism if you heat it above a certain point, known as its Curie temperature. Iron has a Curie temperature of 770C (1300F), while for nickel the Curie temperature is ~355C (~670F). If you heat an iron magnet to 800C (~1500F), it stops being magnetic. You can also destroy or weaken ferromagnetism if you hit a magnet repeatedly.DiamagneticWe can think of paramagnetic and ferromagnetic materials as being "fans" of magnetism: in a sense, they "like" magnetism and respond positively to it by allowing themselves to be magnetized. Not all materials respond so enthusiastically. If you hang some materials in magnetic fields, they get quite worked up inside and resist: they turn themselves into temporary magnets to resist magnetization and weakly repel magnetic fields outside themselves. We call these materials diamagnetic. Water and lots of organic (carbon-based) substances, such as benzene, behave this way. Tie a diamagnetic material to a thread and hang it in a magnetic field and it will turn so it makes an angle of 180 to the field. What causes magnetism?In the early 20th century, before scientists properly understood the structure of atoms and how they work, they came up with an easy-to-understand idea called the domain theory to explain magnetism. A few years later, when they understood atoms better, they found the domain theory still worked but could itself be explained, at a deeper level, by the theory of atoms. All the different aspects of magnetism we observe can be explained, ultimately, by talking about either domains, electrons in atoms, or both. Let's look at the two theories in turn. Explaining magnetism with the domain theoryImagine a factory somewhere that makes little bar magnets and ships them out to schools for their science lessons. Picture a guy called Dave who has to drive their truck, transporting lots of cardboard boxes, each one with a magnet inside it, to a different school. Dave doesn't have time to worry which way the boxes are stacked, so he piles them inside his truck any old how. The magnet inside one box could be pointing north while the one next to it is pointing south, east, or west. Overall, the magnets are all jumbled up so, even though magnetic fields leak out of each box, they all cancel one another out.The same factory employs another truck driver called Bill who couldn't be more different.He likes everything tidy, so he loads his truck a different way, stacking all the boxes neatly so they line up exactly the same way. Can you see what will happen? The magnetic field from one box will align with the field from all the other boxes... effectively turning the truck into one giant magnet. The cab will be like a giant north pole and the back of the truck a huge south pole!What happens inside these two trucks is what happens on a tiny scale inside magnetic materials. According to the domain theory, something like an iron bar contains lots of tiny pockets called domains. Each domain is a bit like a box with a magnet inside. See where we're heading? The iron bar is just like the truck. Normally, all its onboard "boxes" are arranged randomly and there's no overall magnetism: the iron is not magnetized. But arrange all the boxes in order, make them all face the same way, and you get an overall magnetic field: hey presto, the bar is magnetized.When you bring a magnet up to an unmagnetized iron bar and stroke it systematically and repeatedly up and down, what you're doing is rearranging all the magnetic "boxes" (domains) inside so they point the same way.Domain theory explains what happens inside materials when they are magnetized. In an unmagnetized material (left), the domains are randomly arranged so there is no overall magnetic field. When you magnetize a material (right), by stroking a bar magnet over it repeatedly in the same direction, the domains rearrange so their magnetic fields align, producing a combined magnetic field in the same direction.This theory explains how magnetism can arise, but can it explain some of the other things we know about magnets? If you chop a magnet in half, we know you get two magnets, each with a north and south pole. That makes sense according to the domain theory. If you cut a magnet in half, you get a smaller magnet that's still packed with domains, and these can be arranged north-south just like in the original magnet. What about the way magnetism disappears when you hit a magnet or heat it? That can be explained too. Imagine the van full of orderly boxes again. Drive it erratically, at really high speed, and it's a bit like shaking or hammering it. All the boxes will jumble up so they face different ways and the overall magnetism will disappear.Heating a magnet agitates it internally and jumbles up the boxes in much the same way.Explaining magnetism with the atomic theoryThe domain theory is easy enough to understand, but it's not a complete explanation. We know that iron bars aren't full of boxes packed with little magnets and, if you think about, trying to explain a magnet by saying it's full of smaller magnets isn't really an explanation at all, because it immediately prompts the question: what are the smaller magnets made of? Fortunately, there's another theory we can turn to.Back in the 19th century, scientists discovered they could use electricity to make magnetism and magnetism to make electricity. James Clerk Maxwell said that the two phenomena were really different aspects of the same thing electromagnetism like two sides of the same piece of paper. Electromagnetism was a brilliant idea, but it was more of a description than an explanation: it showed how things were rather than explaining why they were that way. It wasn't until the 20th century, when later scientists came to understand the world inside atoms, that the explanation for electromagnetism finally appeared. We know everything is made of atoms and that atoms are made up of a central lump of matter called the nucleus. Minute particles called electrons move around the nucleus in orbit, a bit like satellites in the sky above us, but they also spin on their axis at the same time (just like spinning tops). We know electrons carry electric currents (flows of electricity) when they move through materials such as metals.Electrons are, in a sense, tiny particles of electricity. Now back in the 19th century, scientists knew that moving electricity made magnetism. In the 20th century, it became clear that magnetism was caused by electrons moving inside atoms and creating magnetic fields all around them. Domains are actually groups of atoms in which spinning electrons produce an overall magnetic field pointing one way or another. Artwork: Magnetism is caused by electrons orbiting and spinning inside atoms. Note that this picture is not drawn to scale: most of an atom is empty space and the electrons are actually much further from the nucleus than I've drawn here. Like the domain theory, atomic theory can explain many of the things we know about magnets, including paramagnetism (the way magnetic materials line up with magnetic fields). Most of the electrons in an atom exist in pairs that spin in opposite directions, so the magnetic effect of one electron in a pair cancels out the effect of its partner. But if an atom has some unpaired electrons (iron atoms have four), these produce net magnetic fields that line up with one another and turn the whole atom into a mini magnet. When you put a paramagnetic material such as iron in a magnetic field, the electrons change their motion to produce a magnetic field that lines up with the field outside.What about diamagnetism? In diamagnetic materials, there are no unpaired electrons,so this doesn't happen. The atoms have little or no overall magnetism and are less affected by outside magnetic fields. However, the electrons orbiting inside them are electrically charged particles and, when they move in a magnetic field, they behave like any other electrically charged particles in a magnetic field and experience a force. That changes their orbits very slightly, producing some net magnetism that opposes the very thing that causes it (according to the classic bit of electromagnetic theory know as Lenz's law, which is related to the law of conservation of energy).As a result, the weak magnetic field they produce opposes the magnetic field that causes it which is exactly what we see when diamagnetic materials try to "fight" the magnetic field they're placed in.A brief history of magnetismAncient world: Magnetism is known to the ancient Greeks, Romans, and Chinese. The Chinese use geomantic compasses (ones with wooden inscriptions arranged in rings around a central magnetic needle) in Feng Shui. Magnets gain their name from Manisa in Turkey, a place one named Magnesia, where magnetic lodestone was found in the ground.13th century: Magnetic compasses are first used for navigation in western nations. Frenchman Petrus Perigrinus (also called Peter of Maricourt) makes the first proper studies of magnetism.17th century: English physician and scientist William Gilbert (15441603) publishes On Magnets, his monumental scientific study of magnetism, and proposes that Earth is a giant magnet.18th century: Englishman John Michell (172493) and Frenchman Charles Augustin de Coulomb (17361806) study the forces magnets can exert. Coulomb also makes important studies of electricity, but fails to connect electricity and magnetism as parts of the same underlying phenomenon.19th century: Danishman Hans Christian Oersted (17771851), Frenchmen AndrMarie Ampre (17751836) and Dominique Arago (17861853), and Englishman Michael Faraday (17911867) explore the close connections between electricity and magnetism. James Clerk Maxwell (18311879) publishes a relatively complete explanation of electricity and magnetism (the theory of electromagnetism) and suggests electromagnetic energy travels in waves (paving the way for the invention of radio).Pierre Curie (18591906) demonstrates that materials lose their magnetism above a certain temperature (now known as the Curie temperature). Wilhelm Weber (18041891) develops practical methods for detecting and measuring the strength of a magnetic field.20th century: Paul Langevin (18721946) elaborates on Curie's work with a theory explaining how magnetism is affected by heat. French physicist Pierre Weiss (18651940) proposes there are particles called magnetrons, equivalent to electrons, that cause the magnetic properties of materials and outlines the theory of magnetic domains.Two American scientists, Samuel Abraham Goudsmit (190278) and George Eugene Uhlenbeck (190088), show how magnetic properties of materials result from the spinning motion of electrons inside them. Chris Woodford is the author and editor of dozens of science and technology books for adults and children, including DK's worldwide bestselling Cool Stuff series and Atoms Under the Floorboards, which won the American Institute of Physics Science Writing award in 2016. You can hire him to write books, articles, scripts, corporate copy, and more via his website chriswoodford.com. We have lots of other articles related to magnetism and the things that use it, including: BooksFor younger readers For older readersHidden Attraction: The History and Mystery of Magnetism by Gerrit L. Verschuur. Oxford University Press, 2013. More history than mystery, thank goodness, and well worth a read.Magnetism: A Very Short Introduction by Stephen Blundell. Oxford University Press, 2012. A condensed (142-page) overview that takes us from early ideas of Earth's magnetism to quantum theory, relativity, and more. The Man Who Changed Everything by Basil Mahon, John Wiley, 2003. A readable and easy-to-understand introduction to James Clerk Maxwell's life and work.Electricity and Magnetism by W.J. Duffin. McGraw Hill, 2001. A brilliantly clear undergraduate text (and the one I used as a physics student).James Clerk Maxwell by James R. Newman, Scientific American, 1955. Quite an old article, but still worth reading. It's an excellent summary of Maxwell's life as a mathematical physicist and explains very vividly how he visualized electromagnetism before figuring out the math behind it. [Subscription/payment]De Magnete by William Gilbert, Chiswick Press, 1600. Thanks to Project Gutenberg, you can read the whole text of Gilbert's book online. VideosWhat is the magnetic field? by David Colarusso. A good, clear introduction to magnetic fields and how to draw them with magnetic field lines (2.5 minutes).MIT: 8.02: Electricity and Magnetism by Walter Lewin. A much more detailed undergraduate course from the inspiring Dutch-born MIT physics professor (48 minutes), including some fun demonstrations. Articles Share copy and redistribute the material in any medium or format for any purpose, even commercially. Adapt remix, transform, and build upon the material for any purpose, even commercially. The licensor cannot revoke these freedoms as long as you follow the license terms. Attribution You must give appropriate credit , provide a link to the license, and indicate if changes were made . You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. ShareAlike If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original. No additional restrictions You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits. You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation . No warranties are given. The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. According to the CBSE Syllabus 2023-24, this chapter has been renumbered as Chapter 12. Class 10 science chapter 13 focuses on magnetic fields and electromagnetic effects. How the magnetic effect of electric current is applied to electromagnets and electric motors is examined in the chapter.Chapter Summary VideoMagnetic Field and Field LinesMagnetA magnet is a material that produces a field that attracts or repels other such materials of magnetic nature.Lodestone is a naturally occurring magnet. It attracts materials like Iron, Nickel, Cobalt, etc.A magnet is always bipolar, with poles named north and south poles. These two poles always exist together and can not be separated. The north pole of a magnet is the side which points to the Earths geographic north when it is freely suspended.Similar to charges, poles attract and repel. Like poles repel while unlike poles attract each other.To know more about Magnet, visit here.Bar magnetA bar magnet is a rectangular object composed of iron, steel or any form of a ferromagnetic substance that shows permanent magnetic properties. It has two different poles, a north and a south pole, such that when suspended freely, the north pole aligns itself towards the geographic north pole of the Earth.Magnetic FieldThe region around a magnet where its magnetic influence can be experienced is called a magnetic field. The direction and strength of a magnetic field are represented by magnetic lines of force.For more information on Magnetic Field and Magnet Field Lines, watch the below videoTo know more about Magnetic Field, visit here.Magnetic Field LinesA magnets magnetic field lines result in the formation of continuous/running closed loops.The tangent to the field line at any given point indicates the direction of the total magnetic field at that point.The greater the number of field lines crossing per unit area, the higher the intensity and the stronger the magnitude of the magnetic field.There is no intersection between the magnetic field lines.Magnetic Field Lines for a Closed LoopSince magnets have dipoles, magnetic field lines must originate and end. Therefore by convention, it starts at the north pole and moves towards the south pole outside the bar magnet and from south north inside the magnet. Hence, it forms closed loops. The closer or denser the magnetic field lines, the greater the magnetic fields strength.Iron Filings Test around a Bar MagnetIron filings around a bar magnet exhibit the magnetic field lines that engirdle the bar magnet. The magnetic field lines can be explained as imaginary lines that graphically represent the magnetic field that is acting around any magnetic substance.Magnetic field lines do not intersect as there will be two tangential magnetic field directions associated with the same point, which does not occur. If a compass needle is placed at that point, it will show two different directions of the magnetic field, which is absurd.To know more about the Properties of Magnetic Field Lines, visit here.Magnetic Field Due to a Current Carrying ConductorOersteds ExperimentWhen electric current flows through a current-carrying conductor, it produces a magnetic field around it. This can be seen with the help of a magnetic needle which shows deflection. The more the current, the higher the deflection. If the direction of the current is reversed, the direction of deflection is also reversed.Electromagnetism and ElectromagnetAn electromagnet is an artificial magnet which produces a magnetic field on the passage of electric current through a conductor. This field disappears when the current is turned off. The phenomenon of producing or inducing a magnetic field due to the passage of electric current is called electromagnetism.For more information on Introduction to Electromagnetism, watch the below videoTo know more about Electromagnets, visit here.Magnetic Field Due to a Straight Current-Carrying ConductorWhen current is passed through a straight current-carrying conductor, a magnetic field is produced around it. Using the iron filings, we can observe that they align themselves in concentric circles around the conductor.To know more about the Magnetic field due to current-carrying conductors, visit here.Right-Hand Thumb RuleIf a straight conductor is held in the right hand in such a way that the thumb points along the direction of the current, then the tips of the fingers or the curl of the fingers show the direction of the magnetic field around it.Magnetic Field Due to Current through a Circular LoopThe right-hand thumb rule can be used for a circular conducting wire as well as it comprises of small straight segments. Every point on the wire carrying current gives rise to a magnetic field that appears as straight lines at the centre.Magnetic Field Due to Current in a SolenoidA solenoid is a coil of many circular windings wrapped in the shape of a cylinder. When current is passed through it, it behaves similarly to a bar magnet, producing a very similar field pattern as that of a bar magnet. To increase the strength, a soft iron core is used.Force on a Current-Carrying Conductor in a Magnetic FieldAmperes ExperimentWhen an electric conductor is placed in a magnetic field, it experiences a force. This force is directly proportional to the current and is also perpendicular to its length and magnetic field.Force on a straight current-carrying conductor is mutually perpendicular to the magnetic field and the direction of the current.To know more about Magnetic Force, visit here. Also Read: Magnetic Field in a Solenoid FormulaFlemings Left-Hand RuleFlemings left-hand rule states that the direction of force applied to a current-carrying wire is perpendicular to both the direction of current as well as the magnetic field. To know more about Flemings left-hand rule and Flemings right-hand rule, visit here.Electric MotorAn electric motor converts electrical energy into mechanical energy.Current enters arm AB through brush X, and current flows through brush Y from C to D. Using Flemings LHR, we find that the force pushes AB downwards and pushes CD upwards.In an electric motor, the split rings PQ act as a commutator that reverses the direction of the current. The reversing of the current is repeated at each half-rotation, giving rise to a continuous rotation of the coil.To know more about Electric motor, visit here.Electromagnetic Induction and Electric GeneratorsFaradays ExperimentFaraday discovered that a magnetic field interacts with an electric circuit by inducing a voltage known as EMF (electromotive force) by electromagnetic induction.Moving a magnet towards a coil sets up a current in the coil circuit, as indicated by deflection in the galvanometer needle.Electromagnetic InductionThe phenomenon of electromagnetic induction is the production of induced EMF and, thereby, current in a coil due to the varying magnetic field with time. If a coil is placed near a current-carrying conductor, the magnetic field changes due to a change in I or due to the relative motion between the coil and conductor. The direction of the induced current is given by Flemings right-hand rule.To know more about Faradays Laws of Electromagnetic Induction, visit here.Flemings Right-Hand RuleAccording to Flemings right-hand rule, the thumb, forefinger and middle finger of the right hand are stretched to be perpendicular to each other, as indicated below. If the thumb indicates the direction of the movement of the conductor, the forefinger indicates the direction of the magnetic field, then the middle finger indicates the direction of the induced current.Electric GeneratorConverts mechanical energy into electrical energy.Operates on the principle of electromagnetic induction.AC Generation: The axle attached to the two rings is rotated so that the arms AB and CD move up and down, respectively, in the produced magnetic field. Thus, the induced current flows through ABCD.After half rotation, the direction of the current in both arms changes. Again by applying Flemings right-hand rule, the induced currents are established in these arms along directions DC and BA; therefore, the induced I flows through DCBA.DC Generation: They work just like AC; they use half rings to produce current in one direction only without variations in magnitude.To know more about Electric generators, visit here.Domestic Electric CircuitsFuseA fuse is a protective device in an electrical circuit in times of overloading.Overloading is caused when the neutral and live wires come in contact due to damage to the insulation or a fault in the line.In times of overloading, the current in the circuit increases (short circuit) and becomes hazardous. Joules heating (resistive or ohmic heating on the passage of current) in the fuse device melts the circuit and breaks the flow of current in the circuit.Domestic Electric CircuitsLivewire has a voltage of 220 V and is covered with red insulation.Earth wire has a voltage of 0 V (the same as Earth) and is covered with green insulation.The neutral wire has black insulation.In our houses, we receive AC electric power of 220 V with a frequency of 50 Hz.Power Loss in TransmissionPower losses in transmission lines over long distances occur due to Joules heating. This heat (H)I2Rcauses losses, where R is the line resistance.Joules Law of HeatingJoules law is a mathematical description of the rate at which resistance in a circuit converts electric energy into heat energy. The joules first law shows the relationship between heat produced by flowing electric current through a conductor and is given by the following formula: The characteristics of a magnet to attract or pull other magnets/magnetic objects are known as magnetism.A major benefit of having a magnetic field is its use of navigation. The Earth is a place of habitation because of its magnetic fields.Although they have been used in various diagnostic devices in the health sector and as therapeutic tools, magnets are potentially harmful to the body and pose an increased risk of accidents. Home Practice For learners and parents For teachers and schools Past papers Textbooks Mathematics Mathematics Grade 7 Mathematics Grade 8 Mathematics Grade 9 Mathematics Grade 10 Mathematics Grade 11 Mathematics Grade 12 Mathematical Literacy Mathematical Literacy Grade 10 Physical Sciences Physical Sciences Grade 10 Physical Sciences Grade 11 Physical Sciences Grade 12 Natural Sciences Natural Sciences Grade 4 Natural Sciences Grade 5 Natural Sciences Grade 6 Natural Sciences Grade 7 Natural Sciences Grade 8 Natural Sciences Grade 9 Life Sciences CAT CAT Grade 10 CAT Grade 11 CAT Grade 12 IT IT Grade 10 IT Grade 11 IT Grade 12 Full catalogue Leaderboards Learners Leaderboard Grades Leaderboard Schools Leaderboard Campaigns Learner opportunities Pricing Support Log in Yes, I reside in South Africa Change country/curriculum Enjoy sharper detail, more accurate color, lifelike lighting, believable backgrounds, and more with our new model update. 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Magnetic field due to current in a solenoid.Magnet is an object that attracts objects made of iron, cobalt and nickle. Magnet comes to rest in North South direction, when suspended freely. Use of Magnets: Magnets are usedin refrigerators.in radio and stereo speakers.in audio and video cassette players.in childrens toys and;on hard discs and floppies of computers.Properties of Magnet A free suspended magnet always points towards the north and south direction.The pole of a magnet which points toward north direction is called north pole or north-seeking.The pole of a magnet which points toward south direction is called south pole or south seeking.Like poles of magnets repel each other while unlike poles of magnets attract each other.Magnetic field: The area around a magnet where a magnetic force is experienced is called the magnetic field. It is a quantity that has both direction and magnitude, (i.e., Vector quantity).Magnetic field and field lines: The influence of force surrounding a magnet is called magnetic field. In the magnetic field, the force exerted by a magnet can be detected using a compass or any other magnet. The magnetic field is represented by magnetic field lines.The imaginary lines of magnetic field around a magnet are called field line or field line of magnet. When iron fillings are allowed to settle around a bar magnet, they get arranged in a pattern which mimicks the magnetic field lines. Field line of a magnet can also be detected using a compass. Magnetic field is a vector quantity, i.e. it has both direction and magnitude.Direction of field line: Outside the magnet, the direction of magnetic field line is taken from North pole to South Pole. Inside the magnet, the direction of magnetic field line is taken from South pole to North pole. Strength of magnetic field: The closeness of field lines shows the relative strength of magnetic field, i.e. closer lines show stronger magnetic field and vice versa. Crowded field lines near the poles of magnet show more strength.Properties of magnetic field lines(i) They do not intersect each other.(ii) It is taken by convention that magnetic field lines emerge from North pole and merge at the South pole. Inside the magnet, their direction is from South pole to North pole. Therefore magnetic field lines are closed curves.Magnetic field lines due to a current carrying straight conductorA current carrying straight conductor has magnetic field in the form of concentric circles, around it. Magnetic field of current carrying straight conductor can be shown by magnetic field lines.The direction of magnetic field through a current carrying conductor depends upon the direction of flow electric current.Let a current carrying conductor be suspended vertically and the electric current is flowing from south to north. In this case, the direction of magnetic field will be anticlockwise. If the current is flowing from north to south, the direction of magnetic field will be clockwise.The direction of magnetic field, in relation to direction of electriccurrent through a straight conductor can be depicted by using the Right Hand Thumb Rule. It is also known as Maxwells Corkscrew Rule. Right-Hand Thumb Rule: If a current carrying conductor is held by right hand, keeping the thumb straight and if the direction of electric current is in the direction of thumb, then the direction of wrapping of other fingers will show the direction of magnetic field.Maxwells Corkscrew rule: As per Maxwells Corkscrew Rule, if the direction of forward movement of screw shows the direction of the current, then the direction of rotation of screw shows the direction of magnetic field. Properties of magnetic fieldThe magnitude of magnetic field increases with increase in electric current and decreases with decrease in electric current.The magnitude of magnetic field produced by electric current decreases with increase in distance and vice versa. The size of concentric circles of magnetic field lines increases with distance from the conductor, which shows that magnetic field decreases with distance.Magnetic field lines are always parallel to each other.No two field lines cross each other.Magnetic field lines due to a current through a circular loopIn case of a circular current carrying conductor, the magnetic field is produced in the same manner as it is in case of a straight current carrying conductor.In case of a circular current carrying conductor, the magnetic field lines would be in the form of iron concentric circles around every part of the FllmSs periphery of the conductor. Since, magnetic field lines tend to remain closer when near to the conductor, so the magnetic field would be stronger near the periphery of the loop. On the other hand, the magnetic field lines would be distant from each other when we move towards the centre of the current carrying loop. Finally, at the centre, the arcs of big circles would appear as a straight line. The direction of the magnetic field can be identified using Right Hand Thumbs Rule. Let us assume that the current is moving in anti-clockwise direction in the loop. In that case, the magnetic field would be in clockwise direction, at the top of the loop. Moreover, it would be in an anti-clockwise direction at the bottom of the loop.Clock Face Rule: A current carrying loop works like a disc magnet. The polarity of this magnet can be easily understood with the help of Clock Face Rule. If the current is flowing in anti clockwise direction, then the face of the loop shows north pole. On the other hand, if the current is flowing in clockwise direction, then the face of the loop shows south pole. Magnetic field and number of turns of coil: Magnitude of magnetic field gets summed up with increase in the number of turns of coil. If there are n turns of coil, magnitude of magnetic field will be n times of magnetic field in case of a single turn of coil.The strength of the magnetic field at the centre of the loop(coil) depends on :(i) The radius of the coil: The strength of the magnetic field is inversely proportional to the radius of the coil. If the radius increases, the magnetic strength at the centre decreases(ii) The number of turns in the coil : As the number of turns in the coil increase, the magnetic strength at the centre increases, because the current in each circular turn is having the same direction, thus, the field due to each turn adds up.(iii) The strength of the current flowing in the coil: As the strength of the current increases, the strength of three magnetic fields also increases.Magnetic field due to a current in a Solenoid: Solenoid is the coil with many circular turns of insulated copper wire wrapped closely in the shape of a cylinder. A current carrying solenoid produces similar pattern of magnetic field as a bar magnet. One end of solenoid behaves as the north pole and another end behaves as the south pole.Magnetic field lines are parallel inside the solenoid, similar to a bar magnet, which shows that magnetic field is same at all points inside the solenoid.Magnetic field produced by a solenoid is similar to a bar magnet.The strength of magnetic field is proportional to the number of turns and magnitude of current.By producing a strong magnetic field inside the solenoid, magnetic materials can be magnetized. Magnet formed by producing magnetic field inside a solenoid is called electromagnet.Electromagnet, Flemings Left-Hand Rule, Electric motor, Electromagnetic induction, Flemings right hand rule, Electric generator and domestic elecic circuits.Electromagnet: An electromagnet consists of a long coil of insulated copper wire wrapped on a soft iron.Magnet formed by producing magnetic field inside a solenoid is called electromagnet.Force on a current carrying conductor in a magnetic field: A current carrying conductor exerts a force when a magnet is placed in its vicinity. Similarly, a magnet also exerts equal and opposite force on the current carrying conductor. This was suggested by Marie Ampere, a French Physicist and considered as founder of science of electromagnetism.The direction of force over the conductor gets reversed with the change in direction of flow of electric current. It is observed that the magnitude of force is highest when the direction of current is at right angles to the magnetic field.Flemings Left-Hand Rule: If the direction of electric current is perpendicular to the magnetic field, the direction of force is also perpendicular to both of them. The Flemings Left Hand Rule states that if the left hand is stretched in a way that the index finger, the middle finger and the thumb are in mutually perpendicular directions, then the index finger and middle finger of a stretched left hand show the direction of magnetic field and direction of electric current respectively and the thumb shows the direction of motion or force acting on the conductor. The directions of electric current, magnetic field and force are similar to three mutually perpendicular axes, i.e. x, y, and z-axes.Many devices, such as electric motor, electric generator, loudspeaker, etc. work on Flemings Left Hand Rule.Electric motor: A device that converts electrical energy to mechanical energy. It is of two types : AC and DC Motor.Electrical energy is converted into mechanical energy by using and electric motor. Electric motor works on the basis of rule suggested by Marie Ampere and Flemings Left Hand Rule.Principle of Electric Motor: When a rectangular coil is placed in a magnetic field and a current is passed through it, force acts on the coil, which rotates it continuously. With the rotation of the coil, the shaft attached to it also rotates.Construction: It consists of the following parts :Armature: It is a rectangular coil (ABCD) which is suspended between the two poles of a magnetic field.The electric supply to the coil is connected with a commutator.Commutator or Split ring: Commutator is a device which reverses the direction of flow of electric current through a circuit. It is two halves of the same metallic ring.Magnet: Magnetic field is supplied bv a permanent magnet NS.Sliding contacts or Brushes Q which are fixed.Battery: These are consists of few cells.Working: When an electric current is supplied to the coil of the electric motor, it gets deflected because of magnetic field. As it reaches the halfway, the split ring which acts as commutator reverses the direction of flow of electric current. Reversal of direction of the current, reverses the direction of forces acting on the coil. The change in direction of force pushes the coil, and it moves another half turn. Thus, the coil completes one rotation around the axle. Continuation of this process keeps the motor in rotation.In commercial motors, electromagnet instead of permanent magnet and armature is used. Armature is a soft iron core with large number of conducting wire turns over it. Large number of turns of conducting wire enhances the magnetic field produced by armature.Uses of motors :Used in electric fans.Used for pumping water.Used in various toys.Electromagnetic Induction: Michael Faraday, an English Physicist is supposed to have studied the generation of electric current using a magnetic field and a conductor.Electricity production as a result of magnetism (induced current) is called Electromagnetic Induction.When a conductor is set to move inside a magnetic field or a magnetic field is set to be changing around a conductor, electric current is induced in the conductor. This is just opposite to the exertion of force by a current carrying conductor inside a magnetic field. In other words, when a conductor is brought in relative motion vis a vis a magnetic field, a potential difference is induced in it. This is known as electromagnetic induction.Flemings Right-Hand Rule: Electromagnetic induction can be explained with the help of Flemings Right Hand Rule. If the right hand is structured in a way that the index (fore ginger) finger, middle finger and thumb are in mutually perpendicular directions, then the thumb shows direction of induced current in the conductor, in conductor The directions of movement of conductor, magnetic field and induced current can be compared to three mutually perpendicular axes, i.e. x, y and z axes.The mutually perpendicular directions also point to an important fact that when the magnetic field and movement of conductor are perpendicular, the magnitude of induced current would be maximum.Electromagnetic induction is used in the conversion of kinetic energy into electrical energy.Electric Generator: A device that converts mechanical energy into electrical energy is called an electric generator.Electric generators are of two types: AC generator and a DC generator. Principle of electric generator: Electric motor works on the basis of electromagnetic induction.Construction and Working: The structure of an electric generator is similar to that of an electric motor. In case of an electric generator, a rectangular armature is placed within the magnetic field of a permanent magnet. The armature is attached to wire and is positioned in a way that it can move around an axle. When the armature moves within the magnetic field, an electric current is induced. The direction of induced current changes, when the armature crosses the halfway mark of its rotation.Thus, the direction of current changes once in every rotation. Due to this, the electric generator usually produces alternate current, i.e. A.C. To convert an A.C generator into a D.C generator, a split ring commutator is used. This helps in producing direct current.Electrical generator is used to convert mechanical energy into electrical energy.A.C and D.C CurrentA.C Alternate Current: Current in which direction is changed periodically is called Alternate Current. In India, most of the power stations generate alternate current. The direction of current changes after every 1/100 second in India, i.e. the frequency of A.C in India is 50 Hz. A.C is transmitted upto a long distance without much loss of energy is advantage of A.C over D.C.D.C Direct Current: Current that flows in one direction only is called Direct current. Electrochemical cells produce direct current.Advantages of A.C over D.CCost of generatior of A.C is much less than that of D.C.A.C can be easily converted to D.C.A.C can be controlled by the use of choke which involves less loss of power whereas, D.C can be controlled using resistances which involves high energy loss.AC can be transmitted over long distances without much loss of energy.AC machines are stout and durable and do not need much maintenance.Disadvantages of ACAC cannot be used for the electrolysis process or showing electromagnetism as it reverses its polarity.AC is more dangerous than DC.Domestic Electric Circuits: We receive electric supply through mains supported through the poles or cables. In our houses, we receive AC electric power of 220 V with a frequency of 50 Hz.The 3 wires are as followsLive wire (Red insulated, Positive)Neutral wire (Black insulated, Negative)Earth wire (Green insulated) for safety measure to ensure that any leakage of current to a metallic body does not give any serious shock to a user.Short Circuit: Short-circuiting is caused by the touching of live wires and neutral wire and sudden a large current flows.It happens due todamage pf insulation in power lines.a fault in an electrical appliance.Overloading of an Electric Circuit: The overheating of electrical wire in any circuit due to the flow of a large current through it is called overloading of the electrical circuit.A sudden large amount of current flows through the wire, which causes overheating of wire and may cause fire also.Electric Fuse: It is a protective device used for protecting the circuit from short-circuiting and overloading. It is a piece of thin wire of material having a low melting point and high resistance.Fuse is always connected to live wire.Fuse is always connected in series to the electric circuit.Fuse is always connected to the beginning of an electric circuit.Fuse works on the heating effect.Magnetic field: The area around a magnet in which other magnet feels force of attraction or repulsion is called Magnetic field.Magnetic field lines: The closed curved imaginary lines in the magnetic field which indicate the direction of motion of north pole in the magnetic field if a magnet is free to do so.Properties of magnetic field lines.Magnetic Field lines originate from the north pole of a magnet and end at its south pole.Magnetic Field lines are denser near the poles but rarer at other places.The Magnetic Field lines do not intersect one another.Oersteds experiment: According to this experiment A current carrying wire creates a magnetic field around it. The direction of magnetic field depends on the direction of current in conductor.Magnetic field pattern due to straight current carrying conductor are concentric circles whose center lie on the wire.The direction of magnetic field due to straight current carrying conductor can be determined by Right hand thumb rule.Right hand thumb rule: According to this rule if current carrying conductor is held in the right hand in such a way that thumb indicate the direction of current, then the curled finger indicates the direction of magnetic field lines around conductor.Magnetic field pattern due to current carrying loop: The Magnetic field lines are circular near the current-carrying loop. As we move away from the loop, field lines form bigger and bigger circles. At the center of the circular loop, the magnetic field lines are straight.The solenoid is an insulated and tightly wound long circular wire having large number of turns whose radius is small in comparison to its length. Magnetic field produced by a solenoid is similar to the magnetic field produced by a bar magnet.Current carrying solenoid is called an electromagnet.Properties of magnetic lines of force or magnetic field lines.These lines originate from the north pole and end at the south pole.The magnetic field lines of a magnet form a continuous closed loop.Two magnetic lines of force do not intersect each other.The tangent at any point on the magnetic line gives the direction of the magnetic field at the point.Flemings left hand rule: According to this rule, if the thumb, forefinger and middle finger of the left hand are stretched perpendicular to each other and if the fore-finger gives the direction of magnetic field, middle finger gives the direction of current, then the thumb will give the direction of motion or the force acting on the current-carrying conductor.Principle of an electric motor: A motor works on the principle that when a rectangular coil is placed in a magnetic field and current passes through it, a force acts on the coil which rotates it continuously.When the coil rotates, the shaft attached to it also rotates. In this way the electrical energy supplied to the motor is converted into the mechanical energy of rotation.Principle of an electric generator: It is based on the principle of electromagnetic induction. It states that an induced current is produced in a coil placed in a region where the magnetic field changes with time. The direction of induced current is given by Flemings right-hand rule. An electric generator converts mechanical energy into electrical energy.Electromagnetic induction: The phenomenon of setting up of an electric current or an induced e.mi. by changing the magnetic lines of force by a moving conductor is called electromagnetic induction.Maxwells right hand thumb rule: The direction of the current is given by Maxwells right-hand thumb rule, If the current carrying conductor is gripped with the right hand in such a way that the thumb gives the direction of the current, then the direction of the fingers gives the direction of the magnetic field produced around the conductor.Flemings left-hand rule: The direction of motion of a conductor in a magnetic field is given by Flemings left-hand rule. According to this rule, if the thumb, forefinger and middle finger of the left hand are stretched perpendicular to each other and if fore-finger gives the direction of the magnetic field and the middle finger gives the direction of current then, the thumb will give the direction of the motion of the conductor carrying the current.Flemings right-hand rule: The direction of the induced current is given by Flemings right-hand rule. According to this rule if the thumb, forefinger and middle finger of the right hand are stretched perpendicular to each other and if the fore-finger gives the direction of the magnetic field and the thumb gives the direction of motion, then the middle finger will give the direction of the induced current in the conductor. We hope the given CBSE Class 10 Science Notes Chapter 13 Magnetic Effects of Electric Current Pdf free download will help you. 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Direct Current (DC) is the electric current whose polarity doesn't change with time. Such a current has a fixed magnitude and a fixed direction (polarity).Sources of Direct Current are Batteries and DC generators.The current-time graph of a Direct Current is shown below:Alternating CurrentAlternating Current (AC) is the electric current whose polarity changes with time. Such a current has a variable magnitude and a variable direction (polarity).Sources of Alternating Current are AC generators and Dynamos. Alternating Current is used in Transformers.The current-time graph of an Alternating Current is shown below:Magnetic Effect of Electric CurrentWhen an electric current flows through a conductor, it generates a magnetic field around it. This phenomenon is known as the magnetic effect of electric current and was first observed by Hans Christian Orsted in 1820.Orsted's experiment demonstrated that a compass needle placed near a current-carrying wire deflects, indicating the presence of a magnetic field.Magnetic Field Around a Current-Carrying Conductor and SolenoidThe magnetic field around a straight current-carrying conductor can be determined using Ampere's Circuital Law, which states that the line integral of the magnetic field B around any closed path is equal to 0 times the total current I passing through the enclosed area.Mathematically,$$\rm \oint B \cdot dl = \mu_{o} I$$For a straight conductor, the magnetic field at a distance r from the wire is:$$\rm B = \frac{\mu_{o} I}{2 \pi r}$$where 0 is the permeability of free space ($\rm 4 \pi \times 10^{-7}$ T m/A).When the conductor is shaped into a coil or solenoid, the magnetic field becomes concentrated inside the coil. For a long solenoid with n turns per unit length carrying a current I, the magnetic field inside the solenoid is:$$\rm B = \mu_{o} n I$$Magnetic FluxMagnetic flux is the total magnetic field passing through a given area.Mathematically,$$\rm \phi = \vec{B} \cdot \vec{A} = B \cdot A \cdot \cos (\theta)$$where B is the magnetic field strength, A is the area through which the field lines pass, and$\rm (\theta)$ is the angle between the field lines and the perpendicular to the surface.Motor EffectIt is the phenomenon where a current-carrying conductor placed within a magnetic field experiences a force.Mathematically,$$\rm F = I (\vec{dl} \times \vec{B}) = B I L \sin (\theta)$$This force is described by Fleming's Left-Hand Rule, which states that if we position our left hand such that the thumb, forefinger, and middle finger are mutually perpendicular, the thumb indicates the direction of the force (motion), the forefinger indicates the magnetic field, and the middle finger indicates the current.Electromagnetic InductionElectromagnetic Induction is a current produced because of voltage production (electromotive force) due to a changing magnetic field.Faraday's Law of Electromagnetic InductionFirst law: It states that whenever there is a change in magnetic flux associated with a coil, EMF is induced in that coil.Second law: It states that the magnitude of EMF induced in the coil is directly proportional to the rate of change of magnetic flux associated with that coil.Mathematically, it can be expressed as$$\rm E = - \frac{d \phi}{dt}$$where E is the induced EMF and $\rm \frac{d \phi}{dt}$ is the rate of change of magnetic flux.Dynamo and AC GeneratorA dynamo is a device that converts mechanical energy into electrical energy using the principle of electromagnetic induction.An AC generator operates on the same principle but specifically produces alternating current (AC).In both devices, rotating a coil within a magnetic field induces an electric current in the coil.Large Scale Sources of ElectricityLarge-scale sources of electricity include power plants that utilize various forms of energy such as fossil fuels, nuclear reactions, and renewable sources like hydro, wind, and solar energy.These plants often use turbines and generators to convert mechanical energy into electrical energy.Alternating Current GeneratorAn alternating current generator, or AC generator, produces alternating current by rotating a coil within a magnetic field.The rotation causes the direction of the induced current to reverse periodically, resulting in AC.Transformer: Construction, Working Principle, and TypesA transformer is an electrical device that transfers electrical energy between two or more circuits through electromagnetic induction.It consists of primary and secondary coils wound around a magnetic core.The working principle is based on Faraday's Law of Induction, where an alternating current in the primary coil generates a changing magnetic field, which induces a current in the secondary coil.Types of TransformersStep-Up TransformerA step-up transformer increases the voltage from the primary coil to the secondary coil.This type of transformer has more turns of wire on the secondary coil than on the primary coil.Step-down TransformerA step-down transformer decreases the voltage from the primary coil to the secondary coil.This type of transformer has fewer turns of wire on the secondary coil than on the primary coil.The relationship between the primary and secondary voltages and the number of turns in the coils is given by:$$\rm \frac{V_{S}}{V_{P}} = \frac{N_{S}}{N_{P}}$$where: $\rm V_{S}$ is the secondary voltage, $\rm V_{P}$ is the primary voltage, $\rm N_{S}$ is the number of turns in the secondary coil, $\rm N_{P}$ is the number of turns in the primary coil. Electricity Magnetism Electromagnetism

Magnetism fysik. What is electromagnet class 10th. Magnetism och elektricitet. Define magnetic field class 10th. Magnetism physics. Define magnet class 10. What is magnetism class 10.