

I'm not a robot



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Foray & Sons, Inc. p 146 ISBN78-0-471-29198-5Black, Jeremy and Roy Porter, eds. A Dictionary of Eighteenth-Century World History (1994) 899ppKlekar, Cynthia. "Fictions of the Gift: Generosity and Obligation in Eighteenth-Century English Literature." Innovative Course Design Winner. American Society for Eighteenth-Century Studies: Wake Forest University, 2004. . Refered. Langher, William. An Encyclopedia of World History (5th ed1973): highly detailed outline of events online freeMarris, Richard B. and Graham W. Irwin, eds. Harper Encyclopedia of the Modern World: A Concise Reference. Harvard from 1760 to the Present (1970) onlineMilward, Alan S. and S. B. Saul, eds. The economic development of continental Europe: 17801870 (1973) online; note there are two different books with identical authors and slightly different titles. Their coverage does not overlap.Milward, Alan S. and S. B. Saul, eds. The development of the economies of continental Europe, 18501914 (1977) onlineThe Wallace Collection, London, houses one of the finest collections of 18th-century decorative arts from France, England and Italy, including paintings, furniture, porcelain and gold boxes. 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Spectroscopy is either get scattered, emitted or absorbed, when the radiations meets with the matter. Based on this there are three principles branches of spectroscopy:Absorption spectroscopyScattering spectroscopyEmission spectroscopyThe range in which a material absorbs the electromagnetic spectrum. It involves atomic absorption spectroscopy and diffraction grating molecular techniques that area, such as infrared spectroscopy and radio region nuclear magnetic resonance (NMR) spectroscopy.Emission spectroscopy uses the electromagnetic spectrum (range in which a material radiates (emits)). The material must consume energy first. This energy may come from several sources, such as luminescence, which defines the subsequent emission. Spectro fluorimetry includes molecular luminescence techniques.Scattering spectroscopy tests the amount of light at specific wavelengths, incident angles, and polarization angles that a material scatter. The method of scattering is much quicker than the process of absorption/emission. Raman spectroscopy is one of the most beneficial applications of light scattering spectroscopy.Major types of absorption spectroscopyElectromagnetic radiations Spectroscopic typesX-rayX-ray absorption spectroscopyUV-VisibleUV/Visible absorption spectroscopyIRInfrared absorption spectroscopyMicrowaveMicrowave absorption spectroscopyRadiowaveNuclear magnetic resonance spectroscopyPrinciples of absorption spectroscopyAbsorption spectroscopy is based on law known as Beer-Lambert law.When electromagnetic radiations pass or fall onto homogeneous medium, some amount of light is reflected, some amount is absorbed and remained is transmitted.Absorption spectroscopy is governed by two laws i.e., Lambert's law and Beers law, in the combined form it is known as Beer-Lambert law.Lamberts law: It states that when monochromatic light passes through a transparent medium, the intensity of transmitted light decreases exponentially as the thickness of absorbing material increases.Beers law: It states that the intensity of transmitted monochromatic light decreases exponentially as the concentration of the absorbing substances increases.A= log I0 / I e.c.lA = absorbancelo = intensity of incident lightI = intensity of light through the sample.e = extinction coefficient or absorption coefficient.c = concentrationI = path length (cm)Applications of spectroscopySpectroscopy used for cure monitoring ofcompositesusinoptical fibers.It is most commonly used for estimating weathered wood exposure times using near infrared spectroscopy.Absorption spectroscopy is usually used both visible and infrared spectrum for Measurement of different compounds in food samples.For the measurement of toxic compounds in blood samplesNon-destructive elemental analysis byX-ray fluorescence. It also used in the electronic structure research by using various types of spectroscopy. Reference and Sources /en.wikipedia.org/wiki/Spectroscopy /www.chegg.com/homeework-help/questions-and-answers/ecd-absorbance-optical-density-od-equal-log-i0-i-unintless-i0-intensity-light-irradiating-sam-q1148165 /edurev.in/studytube/Spectroscopy-Principles-Theory/Techniques-and-App/d0bb4b0e-97ec-4e41-8591-0bd850bf23af_pAlso Read: Analytical method using radiation to identify chemical elements in a sampleInductively coupled plasma atomic emission spectrometerAtomic emission spectroscopy (AES) is a method of chemical analysis that uses the intensity of light emitted from a flame, plasma, arc, or spark at a particular wavelength to determine the quantity of an element in a sample. The wavelength of the atomic spectral line in the emission spectrum gives the identity of the element while the intensity of the emitted light is proportional to the number of atoms of the element. The sample may be excited by various methods.Atomic Emission Spectroscopy allows us to measure interactions between electromagnetic radiation and physical atoms and molecules. This interaction is measured in the form of electromagnetic waves representing the changes in energy between atomic energy levels. When elements are burned by a flame, they emit electromagnetic radiation that can be recorded in the form of spectral lines. Each element has its own unique spectral line because each element has a different atomic arrangement, so this method is an important tool for identifying the makeup of materials. Robert Bunsen and Gustav Kirchhoff were the first to establish atomic emission spectroscopy as a tool in chemistry.[1]When an element is burned in a flame, its atoms move from the ground electronic state to the excited electronic state. As atoms in the excited state move back down into the ground state, they emit light. The Boltzmann expression is used to relate temperature to the number of atoms in the excited state where larger temperatures indicate a larger population of excited atoms. This relationship is written as: n u p p e r l o w e r = g u p p e r g l o w e r / k B T {\displaystyle {\frac {n_{upper}}{n_{lower}}}}={\frac {g_{upper}}{g_{lower}}}\,}e^{-(\varvarepsilon_{\mathrm{upper}}-\varvarepsilon_{\mathrm{lower}})/k\,B\,T} where n upper and n lower are the number of atoms in the higher and lower energy levels, g upper and g lower are the degeneracies in the higher and lower energy levels, and k B T is the Boltzmann constant. The wavelengths of this light can be dispersed and measured by a monochromator, and the intensity of the light can be leveraged to determine the number of excited state electrons present.[2] For atomic emission spectroscopy, the radiation emitted by atoms in the excited state are measured specifically after they have already been excited.Much information can be obtained from the use of atomic emission spectroscopy by interpreting the spectral lines produced from exciting an atom. The width of spectral lines can provide information about an atoms kinetic temperature and electron density. Looking at the different intensities of spectral lines is useful for determining the chemical makeup of mixtures and materials. Atomic emission spectroscopy is mainly used for determining the makeup of mixes of molecules because each element has its own unique spectrum.[3]A flame during the assessment of calcium ions in a flame photometerThe sample of a material (analyte) is brought into the flame as a gas, sprayed solution, or directly inserted into the flame by use of a small loop of wire, usually platinum. The heat from the flame evaporates the solvent and breaks intramolecular bonds to create free atoms. The thermal energy also excites the atoms into excited electronic states that subsequently emit light when they return to the ground electronic state. Each element emits light at a characteristic wavelength, which is dispersed by a grating or prism and detected in the spectrometer.Sodium atomic ions emitting light in a flame displays a brilliantly bright yellow emission at 588.9950 and 589.5924 nanometers wavelength.A frequent application of the emission measurement with the flame is the regulation of alkali metals for pharmaceutical analytics.[4]Main article: Inductively coupled plasma atomic emission spectroscopyInductively coupled plasma atomic emission sourceInductively coupled plasma atomic emission spectroscopy (ICP-AES) uses an inductively coupled plasma to produce excited atoms and ions that emit electromagnetic radiation at wavelengths characteristic of a particular element.[5][6]Advantages of ICP-AES are the excellent limit of detection and linear dynamic range, multi-element capability, low chemical interference, a stable and reproducible signal. Disadvantages are spectral interferences (many emission lines), cost and operating expense of the face torch made from concentric quartz tubes to create excitement in the material. Thelght source for inductively coupled plasma atomic emission spectroscopy (ICP-AES) is a high-frequency inductively coupled plasma.AES uses wavelengths between the upper vacuum ultraviolet (160 nm) to visible light (800 nm). It entails the excitation and de-excitation of electrons by radiation absorption. Electromagnetic radiation (EMR) is measured and evaluated when an electron transitions from an excited to a de-excited state. The optical quality of radiation during the de-excitation process gives rise to the name optical emission spectroscopy (OES). Because the spectral line has a fixed wavelength, measurement in atomic emission spectroscopy is possible. In this procedure, a sprayed solution or gas containing a sample of the substanteco to be examined is exposed to flame. When the flame heat evaporates the solvent and destroys the chemical bonds of the analyte, free atoms of the substance are created. Heat also causes atoms to become electrically charged particles, which emit light when they return to their ground electronic state. The flame photometer principle is based on measuring the intensity of emitted light when a metal is introduced into the flame. The wavelength of the color indicates the element, and the color of the flame indicates the numberofelements presentin the sample. Frequencies in the microwave region are employed as an external energy source in a microwave induced plasma (MIP) source. It is typical to use microwave radiation with a frequency of 2450 MHz. When ultrahigh frequency ac power is capacitively coupled into a stream of noble gas (helium or argon) or nitrogen at around 3 dm3/min in a resonant cavity, a microwave induced plasma is formed. The heated plasma is maintained in this process by a support gas, commonly argon, which is focussed by a high-energy CO2 laser source. Spark and arc excitation sources use a spark, an electric pulse, or a continuous electrical discharge are between two electrodes to vaporize and excite the samples atoms. Monochromators are prisms and diffraction gratings. These are used to select the specific kind of radiation generated by the analyte and to remove any other undesirable radiation. As a result, it is also known as the wavelength selector. Diffraction gratings produce more accuracy and resolution than prisms. Gratings are utilized as a dispersive element in the AES spectrometer to disperse incident light into component wavelengths. The light is reflected off the angled grating surface, causing wavelengths to be distributed through constructive interference at wavelength-dependent diffraction angles. Because all atoms in a sample are excited at the same time, they can be detected sequentially using a monochromator or simultaneously using a polychromatorwith multiple detectors. Detectors are transducers that convert the spectrometers analog output into an electric signal that can be seen and processed on a computer. In atomic emission spectroscopy, detectors include photomultiplier tubes (PMTs), charge-coupled devices (CCDs), and charge-injection devices (CIDs). They convert optical impulses into electrical current, which the amplifier subsequently amplifies. The amplifiers receive signals from the detectors and amplify them multiple times such that they are usable or comparable. Atomic emission spectroscopy employs computers as readout devices. Using the atomic emission ranges library, computers analyze the data in the form of spectra and plot the calibration curve. 1. Lower interelement interference due to increased temperature. 2. Emission spectra are created by using a single set of excitation conditions, and several elements can be recorded at the same time. 3. Multielement analysis can be performed on relatively small samples. 4. Refractory substances with low concentrations can be identified. i. The ICP-AES technology can be used in agriculture to analyze agricultural and food goods. ii. It can be used in earth science to analyze rare earth elements found in rocks. iii. The ICP-AES technique can examine trace metals from alloys, steel, lubricating fluids, and gasoline. iv. Similarly, in biology, the ICP-AES technology can evaluate aluminum from blood, copper from brain tissue, selenium from the liver, and salt from breast milk. v. Inductively coupled plasma atomic emission spectroscopy can detect metal traces such as calcium (Ca), copper (Cu), iron (Fe), manganese (Mn), magnesium (Mg), phosphorus (P), potassium (K), and zinc (Zn) in beer or wine. vi. The quantities of Na+ and K+ ions in the human body are critical for performing numerous metabolic tasks. The quantities of these substances can be measured by diluting and aspirating a blood serum sample into the flame. vii. Flame photometry can be used to determine the amounts of various metals and elements in soft drinks, fruit juices, and alcoholic beverages. viii. The amounts of various metals and elements in soft drinks, fruit juices, and alcoholic beverages can also be determined using flame photometry. ix. AES is used to determine calcium and magnesium in cement. x. AES is used to determine lead in gasoline. xi. Ca, Mg, Na, and K levels in blood serum and plasma were analyzed by using AES. xii. AES is an effective method for detecting metallic toxins.xiii. AES can determine the metallic contents of the soil.xiv. AES can be used to detect adulteration in petroleum products. 1. It is a sensitive methodcapable of detecting concentrations as low as 1 ppm.2. The analysis requires a small sample.3. If proper comparison standards are provided, working time is reduced. 4. There is no need to prepare the sample.5. Solid and liquid samples are easily examined.AnswerEmission spectrometry measures the wavelengths of photons emitted by atoms or molecules as they transition from a high energy state to a lower energy level.It is based on the principle that electrons and compounds emit energy in the form of light when they are heated. The heating element could be an electric heater or a flame.When the emitted light is passed into a spectrometer, it gets dispersed into separate wavelengths. Every element emits a distinctly different set of wavelengths depending on its electronic structure. The elemental composition of the sample can be determined by measuring the wavelengths that are emitted.Additional resourcesDensity fluctuation measurements using beam emission spectroscopy on Heliotron JSpectrum Viewer An analyte in an excited state possesses an energy, E2, that is greater than its energy when it is in a lower energy state, E1. When the analyte returns to its lower energy statea process we call relaxationthe excess energy, E (E = E 2 E 1) must be released. Figure 10.4 shows a simplified picture of this process. The amount of time the analyte spends in the excited electronic states is lifetime, typically 105-109 s for electronic excited states and 1015 s for vibrational excited states. Relaxation of an analyte excited-state, A*, occurs through several mechanisms, including collisions with other species in the sample, by photochemical reactions, and by the emission of photons. In the first process, which is called vibrational relaxation, or nonradiative relaxation, the excess energy is released as heat. {\mathrm{A^{*}\rightarrow A + heat}} {\tag{10.5.2}} Relaxation by a photochemical reaction may involve a decomposition reaction {\mathrm{A^{*}\rightarrow X + Y}} {\tag{10.5.3}} or a reaction between A* and another species {\mathrm{A^{*} + Z\rightarrow X + Y}} {\tag{10.5.4}}. In both cases the excess energy is used up in the chemical reaction or released as heat. In the third mechanism, the excess energy is released as a photon of electromagnetic radiation. {\ce{A^{*}\rightarrowarrow {\ce{A}} + hu}} {\tag{10.5.5}} The release of a photon following thermal excitation is called emission and that following the absorption of a photon is called photoluminescence. In chemiluminescence and bioluminescence, excitation results from a chemical or biochemical reaction, respectively. Spectroscopic methods based on photoluminescence are the subject of the next section and atomic emission is covered in Section 10.7. David Harvey (DePauw University) 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. Atomic emission spectroscopy (AES) is an analytical technique used to quantify metal atoms by measuring the intensity of light produced by the atoms in excited states. When an excited atom returns to its ground state, it emits a specific wavelength of radiation. Excitation (absorption of radiation) and de-excitation (emission of radiation) of electrons are both involved in atomic emission spectroscopy. Atomic emission spectroscopy analyzes the radiation released by atoms to identify their structure, composition, and surroundings. We can derive the energy levels (or stationary states) of the atom from wavelength measurements, and this gives an experimental basis for theories of atomic structure. AES is based on the idea that when energy is delivered to a molecule in the form of light or heat, molecules are excited and shift from a lower energy level state to a higher energy level state. The molecules are unstable at higher energy levels and revert to lower energy levels after producing radiations in the form of photons. The emission spectrometer measures the wavelengths of emitted photons. The basic principle of atomic emission spectroscopy is the study of the wavelengths of photons released by atoms and molecules as they move from a high energy state to a low energy state. Each element or substance emits a distinct set of wavelengths that are determined by its electrical structure. The elemental structure of the sample can be revealed by studying these wavelengths. Fig: Basic principle of atomic emission spectroscopy Before analyzing a sample, it should be transformed into highly excited free atoms.The most convenient way to introduce liquids into the gas stream is via aerosol from a nebulizer. The aerosol could be created by the action of a high-speed jet across the tip of the small aperture, or by some other method.The spectral emissions stability is greatly reliant on droplet sizes. As a result, choosing the right nebulizer type is crucial for producing homogeneous droplet sizes.The appropriate nebulizer depends on sample properties such as density, viscosity, organic content, total dissolved solids, and total sample volume. Fig: Instrumentation of atomic emission spectroscopy Image source: The samples atoms are dissolved, atomized, and excited using an excitation source. The ideal excitation source will allow the excitation of all the elements in the sample and will do so again until the complete elemental excitation in the sample is covered. This excitation method uses two electrodes to generate an electrical discharge that heats the plasma gas, which is commonly argon. This form of stimulation is more suited for materials with a high solids content. This is the most often used excitation method, and it necessitates the use of a plasma torch made from concentric quartz tubes to create excitement in the material. Thelght source for inductively coupled plasma atomic emission spectroscopy (ICP-AES) is a high-frequency inductively coupled plasma.AES uses wavelengths between the upper vacuum ultraviolet (160 nm) to visible light (800 nm). It entails the excitation and de-excitation of electrons by radiation absorption. Electromagnetic radiation (EMR) is measured and evaluated when an electron transitions from an excited to a de-excited state. 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Gratings are utilized as a dispersive element in the AES spectrometer to disperse incident light into component wavelengths. The light is reflected off the angled grating surface, causing wavelengths to be distributed through constructive interference at wavelength-dependent diffraction angles. Because all atoms in a sample are excited at the same time, they can be detected sequentially using a monochromator or simultaneously using a polychromatorwith multiple detectors. Detectors are transducers that convert the spectrometers analog output into an electric signal that can be seen and processed on a computer. In atomic emission spectroscopy, detectors include photomultiplier tubes (PMTs), charge-coupled devices (CCDs), and charge-injection devices (CIDs). They convert optical impulses into electrical current, which the amplifier subsequently amplifies. The amplifiers receive signals from the detectors and amplify them multiple times such that they are usable or comparable. Atomic emission spectroscopy employs computers as readout devices. Using the atomic emission ranges library, computers analyze the data in the form of spectra and plot the calibration curve. 1. Lower interelement interference due to increased temperature. 2. Emission spectra are created by using a single set of excitation conditions, and several elements can be recorded at the same time. 3. Multielement analysis can be performed on relatively small samples. 4. Refractory substances with low concentrations can be identified. i. The ICP-AES technology can be used in agriculture to analyze agricultural and food goods. ii. It can be used in earth science to analyze rare earth elements found in rocks. iii. The ICP-AES technique can examine trace metals from alloys, steel, lubricating fluids, and gasoline. iv. Similarly, in biology, the ICP-AES technology can evaluate aluminum from blood, copper from brain tissue, selenium from the liver, and salt from breast milk. v. Inductively coupled plasma atomic emission spectroscopy can detect metal traces such as calcium (Ca), copper (Cu), iron (Fe), manganese (Mn), magnesium (Mg), phosphorus (P), potassium (K), and zinc (Zn) in beer or wine. vi. The quantities of Na+ and K+ ions in the human body are critical for performing numerous metabolic tasks. The quantities of these substances can be measured by diluting and aspirating a blood serum sample into the flame. vii. Flame photometry can be used to determine the amounts of various metals and elements in soft drinks, fruit juices, and alcoholic beverages. viii. The amounts of various metals and elements in soft drinks, fruit juices, and alcoholic beverages can also be determined using flame photometry. ix. AES is used to determine calcium and magnesium in cement. x. AES is used to determine lead in gasoline. xi. Ca, Mg, Na, and K levels in blood serum and plasma were analyzed by using AES. xii. AES is an effective method for detecting metallic toxins.xiii. AES can determine the metallic contents of the soil.xiv. AES can be used to detect adulteration in petroleum products. 1. It is a sensitive methodcapable of detecting concentrations as low as 1 ppm.2. The analysis requires a small sample.3. If proper comparison standards are provided, working time is reduced. 4. There is no need to prepare the sample.5. Solid and liquid samples are easily examined. Spectroscopy is a scientific technique used to study the interaction between matter and electromagnetic radiation. It helps identify the composition, structure, and properties of substances by analyzing how they absorb, emit, or scatter light. Spectroscopy is the study of the interaction of electromagnetic radiation (light) with atoms and molecules, typically used to determine the structure, concentration, and dynamics of chemical compounds. Spectroscopy is a technique where we studied the interaction between matter and electromagnetic radiation.Matter may be ions, molecules or atoms.This technique employ light tends to interact with matter and exhibit some features of a sample to know much about its consistency or structure.The nature of the interactions in spectroscopy techniques between radiation and matter may includes: absorption, emission or scattering.Spectroscopy techniques are two types:Qualitative spectroscopy: This technique studied the radiation absorbed or emitted by an atom or molecule which will give information about its identity.Quantitative spectroscopy: This technique will give information about the number of absorbing or emitting atoms or molecules by measuring the total amount of radiation.Electromagnetic radiation It is a form of energy and it consists of both magnetic and electric field.It is composed of an electric and a perpendicular magnetic vector, each one oscillating in plane at right angles to the direction of propagation.Electromagnetic spectrum is mainly range from shorter wavelengths to longer wavelengths such as gamma rays.Wavelengths of the visible region of the spectrum is ranges between 400-700 nm.Blue end of the spectrum has shorter wavelengths, while red end has longer wavelengths.In spectrum, energy associated with the given segment is much related to the frequency and wavelength.Frequency (v) of the electromagnetic radiation is the number of oscillations made by wave in 1 second.Frequency is measured in hertz (Hz), Where, 1Hz = 1 cycle per sec.Wavelength (λ): It is the length of on complete wave cycle.Wavelength is generally measured in centimeters (cm).Wavelength is inversely proportional to the frequency.The relation between wavelength and frequency is defined by: v= c/λ , where, c= speed of light.E= hv = hc/ where, Planck's constant (h) = 6.6 X 10-34 joules per second.Wavenumber: It defines the number of completed wave cycles per distance. It is m3asured in 1 cm-1 wavenumber is reciprocal to the wavelength.Types of spectroscopySpectroscopy is the collective terms for diverse group of techniques which involves the interactions of electromagnetic radiation with the matter.Based on this there are three principles branches of spectroscopy:Absorption spectroscopyScattering spectroscopyEmission spectroscopyAbsorption spectroscopy uses the range in which a material absorbs the electromagnetic spectrum. It involves atomic absorption spectroscopy and different molecular techniques that area, such as infrared spectroscopy and radio region nuclear magnetic resonance (NMR) spectroscopy.Emission spectroscopy uses the electromagnetic spectrum range in which a material radiates (emits). The material must consume energy first. This energy may come from several sources, such as luminescence, which defines the subsequent emission. Spectro fluorimetry includes molecular luminescence techniques.Scattering spectroscopy tests the amount of light at specific wavelengths, incident angles, and polarization angles that a material scatter. The method of scattering is much quicker than the process of absorption/emission. Raman spectroscopy is one of the most beneficial applications of light scattering spectroscopy.Major types of absorption spectroscopyElectromagnetic radiations Spectroscopic typesX-rayX-ray absorption spectroscopyUV-VisibleUV/Visible absorption spectroscopyIRInfrared absorption spectroscopyMicrowaveMicrowave absorption spectroscopyRadiowaveNuclear magnetic resonance spectroscopyPrinciples of absorption spectroscopyAbsorption spectroscopy is based on law known as Beer-Lambert law.When electromagnetic radiations pass or fall onto homogeneous medium, some amount of light is reflected, some amount is absorbed and remained is transmitted.Absorption spectroscopy is governed by two laws i.e., Lambert's law and Beers law, in the combined form it is known as Beer-Lambert law.Lamberts law: It states that when monochromatic light passes through a transparent medium, the intensity of transmitted light decreases exponentially as the thickness of absorbing material increases.Beers law: It states that the intensity of transmitted monochromatic light decreases exponentially as the concentration of the absorbing substances increases.A= log I0 / I e.c.lA = absorbancelo = intensity of incident lightI = intensity of light through the sample.e = extinction coefficient or absorption coefficient.c = concentrationI = path length (cm)Applications of spectroscopySpectroscopy used for cure monitoring ofcompositesusinoptical fibers.It is most commonly used for estimating weathered wood exposure times using near infrared spectroscopy.Absorption spectroscopy is usually used both visible and infrared spectrum for Measurement of different compounds in food samples.For the measurement of toxic compounds in blood samplesNon-destructive elemental analysis byX-ray fluorescence. It also used in the electronic structure research by using various types of spectroscopy. Reference and Sources /en.wikipedia.org/wiki/Spectroscopy /www.chegg.com/homeowrk-help/questions-and-answers/ecd-absorbance-optical-density-od-equal-log-i0-i-unintless-i0-intensity-light-irradiating-sam-q1148165 /edurev.in/studytube/Spectroscopy-Principles-Theory/Techniques-and-App/d0bb4b0e-97ec-4e41-8591-0bd850bf23af_pAlso Read: 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. 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