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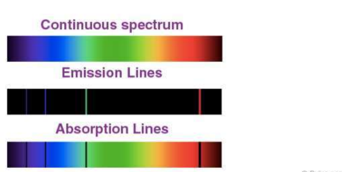
Emission spectral lines

- This spectrum of radiation emitted by electrons in the excited atoms or molecules is known as an emission spectrum.
- Emission spectra are noticed when the radiation emitted from a source is passed through a prism and then received in the photographic plate.
- When white light passes through a slit and then through a glass prism,it splits into seven bands of colours. These colours are a continuous **spectrum**.

- Emission spectrum is also noticed when the vapour of some volatile substances are allowed to fall on the flame of a bunsen burner some specific colour appears on the photographic plate which are different for different substances. This kind of spectra is known as **emission line spectra.**
- The emission spectral line of no two elements resembles each other. Therefore these are regarded as the **fingerprints** of the elements and help their identification.
- Emission spectra lines are the bright lines on the dark background.

Absorption spectral lines

- When white light having all the wavelengths of the visible region is passed through and the transmitted light dispersed by the prism, a few dark lines are obtained in the continuous spectrum. These dark lines are dependent on the nature of the absorbing media, known as **absorption spectral lines**.
- The absorption spectral lines are the dark line on the bright background.
- These dark lines indicate that the radiation corresponding to them is absorbed by the substance from the white light.



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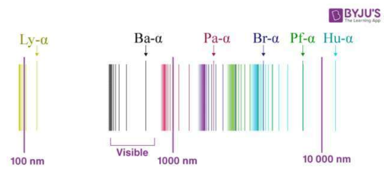
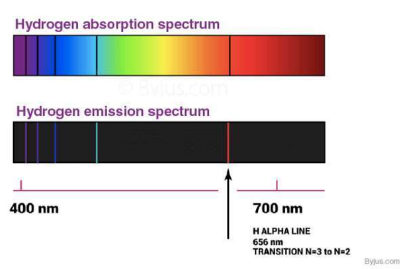
Spectral Lines of Hydrogen atom

- When an electric discharge is passed through hydrogen gas enclosed in a discharge tube under low pressure, a bluish light is emitted. When a ray of light is passed through a prism, a discontinuous line spectrum of several isolated sharp lines is obtained. The wavelengths of various lines show that these lines lie in visible, ultraviolet and infrared regions.All these lines are known as **Hydrogen spectral lines**.
- All the spectral lines observed in the **hydrogen spectrum** (https://byjus.com/physics/spectral-series/) can be classified into different series: Lyman, **Balmer**, **Paschen**, **Brackett** and **Pfund series**.



- The colour of the light emitted by the hydrogen atoms does not depend greatly on the temperature of the gas in the tube. When the emitted light is passed through a prism, only a few narrow lines, which are called **line spectrum**, are emitted or absorbed, rather than a continuous range of wavelengths or a continuous range of colours.
- The light emitted by **hydrogen atoms** is **red** because, of its four characteristic lines, the most intense line in its spectrum is in the red portion of the visible spectrum, at **656 nm**.
- In the case of **sodium**, we observe a **yellow colour** because the most intense lines in its spectrum are in the yellow portion of the spectrum, at about **589 nm.**



Spectral Line broadening and shift

Several other effects can cause the spectral lines we observe to become broader than we would predict due to the Uncertainty Principle. These include:

(a) The Zeeman effect :

- The Zeeman effect is the splitting of the spectral lines of an atom in the presence of a strong magnetic field. The effect is due to the distortion of the electron orbitals because of the magnetic field. At atomic energy levels, the transitions between these levels are influenced by a magnetic field. If there are magnetic fields present, the atomic energy levels are split into a more extensive number of levels and the spectral lines are also split. This splitting is called the Zeeman Effect.

(b) Thermal Doppler broadening

- Doppler effect (https://byjus.com/physics/doppler-effect/) depends on the velocity of the atom relative to the observer. The higher the temperature of the gas, the wider the distribution of velocities in the gas. Since the spectral line is a combination of all of the emitted radiation, the higher the temperature of the gas, the broader the spectral line emitted from that gas.

(c) Collisional broadening

- The collision of other particles with the light emitting particle interrupts the emission process, and by shortening the characteristic time for the process, increases the uncertainty in the energy emitted (as occurs in natural broadening).The duration of the collision is much shorter than the lifetime of the emission process. Hence the spectra get broadened .This effect depends on both the density and the temperature of the gas.

By measuring the amount of broadening we can determine properties such as the temperature and density of a gas, and even identify the presence of a magnetic field.

Frequently Asked Questions on Spectral lines

Q1 **What are the two types of spectral lines?**

A spectral line is a spectrum in which light of only a certain wavelength is emitted or absorbed, rather than a continuous range of wavelengths, rather than a continuous range of colours. A spectral line may be observed either as an **emission line** or an **absorption line**.

Q2 **What are spectrum and its type?**

The splitting of a beam of light into radiations of different wavelengths or frequencies after passing through a prism or diffraction grating is called dispersion and the pattern of radiations observed after dispersion is called spectrum. Spectrum is of two types: (i) Continuous spectrum and (ii) Line spectrum

Q3 **What are atomic spectra?**

The spectrum of electromagnetic radiation produced or absorbed by an electron during transitions between different levels of energy within an atom is called atomic spectra.

Q4 **What are wavelength and frequency?**

Frequency is defined as the number of oscillations of a wave per unit time being measured in hertz(Hz). The distance between two nearest crests or nearest troughs of a wave is called the wavelength.