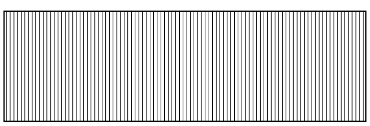
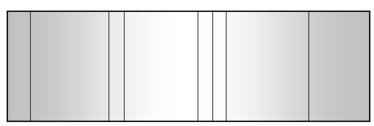
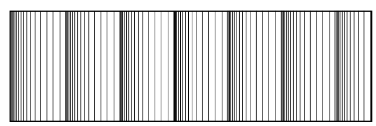
Spectrum.

The ordered arrangements of radiations according to wavelengths or frequencies is called Spectrum. Spectrum can be divided in two parts (I) Emission spectrum and (II) Absorption spectrum.

(1) Emission spectrum: When light emitted by a self-luminous object is dispersed by a prism to get the spectrum, the spectrum is called emission spectra.

Continuous emission spectrum	Line emission spectrum	Band emission spectrum
(i) It consists of continuously varying wavelengths in a definite wavelength range.	(i) It consist of distinct bright lines.	(iii) It consist of district bright bands.
(ii) It is produced by solids, liquids and highly compressed gases heated to high temperature.	(ii) It is produced by an excited source in atomic state.	(ii) It is produced by an excited source in molecular state.
(iii) e.g. Light from the sun, filament of incandescent bulb, candle flame etc.	(iii) e.g. Spectrum of excited helium, mercury vapors, sodium vapors or atomic hydrogen.	(iii) e.g. Spectra of molecular H_2, CO, NH_3 etc.
		

(2) Absorption spectrum : When white light passes through a semi-transparent solid, or liquid or gas, it's spectrum contains certain dark lines or bands, such spectrum is called absorption spectrum (of the substance through which light is passed).

(i) Substances in atomic state produces line absorption spectra. Polyatomic substances such as H_2, CO_2 and $KMnO_4$ produces band absorption spectrum.

(ii) Absorption spectra of sodium vapor have two (yellow lines) wavelengths $D_1 (5890\ \mathring{A})$ and $D_2 (5896\ \mathring{A})$

Note: If a substance emits spectral lines at high temperature then it absorbs the same lines at low temperature. This is Kirchoff's law.

(3) Fraunhoffer's lines: The central part (photosphere) of the sun is very hot and emits all possible wavelengths of the visible light. However, the outer part (chromosphere) consists of vapors of different elements. When the light emitted from the photosphere passes through the chromosphere, certain wavelengths are absorbed. Hence, in the spectrum of sunlight a large number of dark lines are seen called Fraunhoffer lines.

(i) The prominent lines in the yellow part of the visible spectrum were labelled as D-lines, those in blue part as F-lines and in red part as C-line.

(ii) From the study of Fraunhoffer's lines the presence of various elements in the sun's atmosphere can be identified e.g. abundance of hydrogen and helium.

(4) Spectrometer: A spectrometer is used for obtaining pure spectrum of a source in laboratory and calculation of μ of material of prism and μ of a transparent liquid.

It consists of three parts: Collimator which provides a parallel beam of light; Prism Table for holding the prism and Telescope for observing the spectrum and making measurements on it.

The telescope is first set for parallel rays and then collimator is set for parallel rays. When prism is set in minimum deviation position, the spectrum seen is pure spectrum. Angle of prism (A) and angle of minimum deviation (δ_m) are measured and μ of material of prism is calculated using prism formula. For μ of a transparent liquid, we take a hollow prism with thin glass sides. Fill it with the liquid and measure (δ_m) and A of liquid prism. μ of liquid is calculated using prism formula.

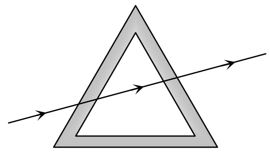
(5) Direct vision spectroscope: It is an instrument used to observe pure spectrum. It produces dispersion without deviation with the help of n crown prisms and $(n-1)$ flint prisms alternately arranged in a tabular structure.

For no deviation $n(\mu-1)A=(n-1)(\mu'-1)A'$.

Concepts

When a ray of white light passes through a glass prism red light is deviated less than blue light.

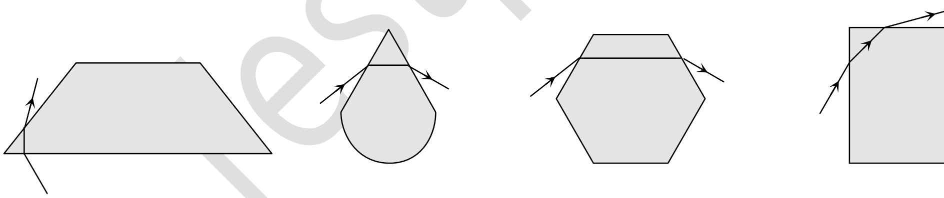
For a hollow prism $A \neq 0$ but $\delta = 0$

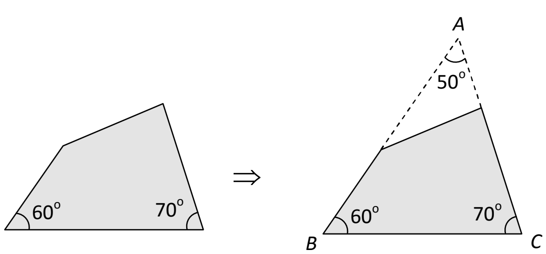


If an opaque colored object or crystal is crushed to fine powder it will appear white (in sun light) as it will lose its property of selective reflection.

Our eye is most sensitive to that part at the spectrum which lies between the F line (sky green) one the C-line (red) of hydrogen equal to the refractive index for the D line (yellow) of sodium. Hence for the dispersive power, the following formula is internationally accepted $\omega = \frac{\mu_F - \mu_C}{\mu_D - 1}$

Sometimes a part of prism is given and we keep on thinking whether how should we proceed? To solve such problems first complete the prism then solve as the problems of prism are solved





Some other types of prism