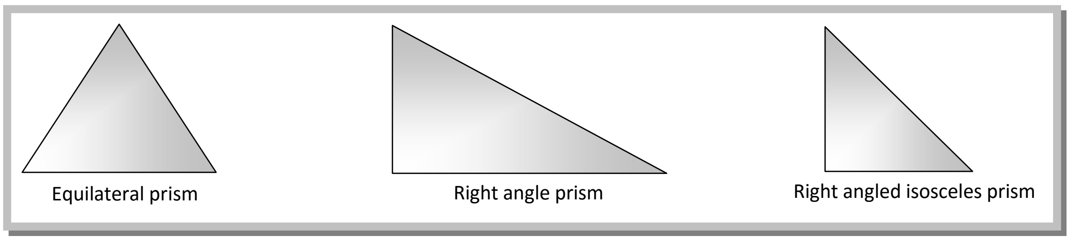
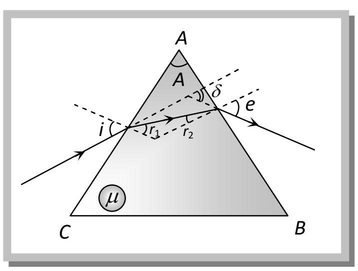
Prism.

Prism is a transparent medium bounded by refracting surfaces, such that the incident surface (on which light ray is incidenting) and emergent surface (from which light rays emerges) are plane and non-parallel.

Commonly used prism:



(1) Refraction through a prism



$A = r_1 + r_2$ and $i + e = A + \delta$

For surface AC $\mu = \frac{\sin i}{\sin r_1}$;

For surface AB $\mu = \frac{\sin r_2}{\sin e}$

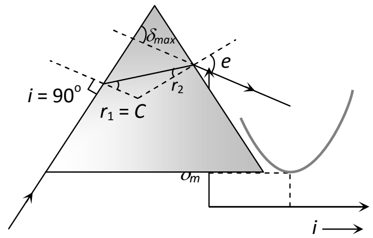
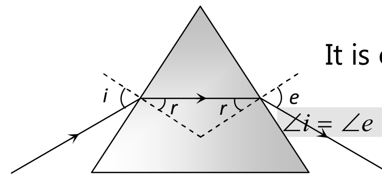
i – Angle of incidence, *e* – Angle of emergence,

A – Angle of prism or refracting angle of

(2) Deviation through a prism

For thin prism $\delta = (\mu - 1)A$. Also deviation is different for different color light e.g. $\mu_R < \mu_V$ so $\delta_R < \delta_V$.

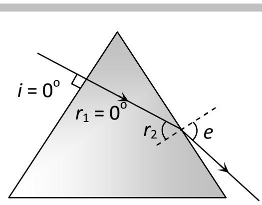
$\mu_{\text{Flint}} > \mu_{\text{Crown}}$ So $\delta_F > \delta_C$

Maximum deviation	Minimum deviation
	 It is observed if $\angle i = \angle e$ and $\angle r_1 = \angle r_2 = r$ then :
In this condition of maximum deviation $\angle i = 90^o$, $r_1 = C, r_2 = A - C$ and from Snell's law on emergent surface $e = \sin^{-1}\left[\frac{\sin(A-C)}{\sin C}\right]$	(i) Refracted ray inside the prism is parallel to the base of the prism
	(ii) $r = \frac{A}{2}$ and $i = \frac{A+\delta_m}{2}$
	(iii) $\mu = \frac{\sin i}{\sin A/2}$ or $\mu = \frac{\sin \frac{A+\delta_m}{2}}{\sin A/2}$

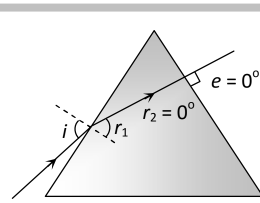
Note: If $\delta_m = A$ then $\mu = 2\cos A/2$

(3) Normal incidence on a prism

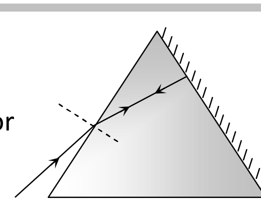
If light ray incident normally on any surface of prism as shown



and



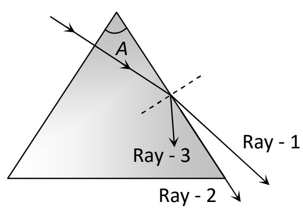
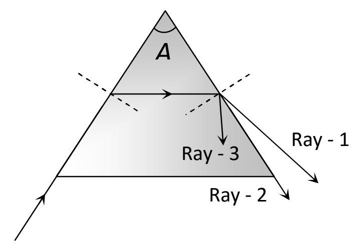
or



In any of the above case use $\mu = \frac{\sin i}{\sin A}$ and $\delta = i - A$

(4) Grazing emergence and TIR through a prism

When a light ray falls on one surface of prism, it is not necessary that it will exit out from the prism. It may or may not be exit out as shown below

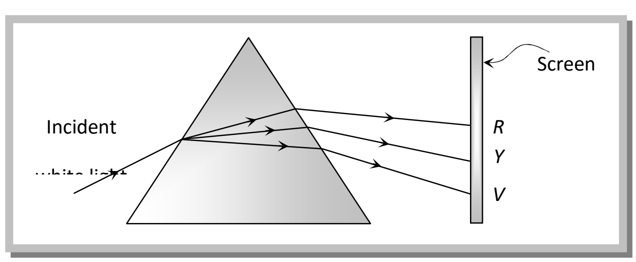
Normal incidence	Grazing incidence
 Ray –1 : General emergence $A<C$ and Ray – 2: Grazing emergence $A = C$ and Ray – 3: TIR $A>C$ and A = angle of prism and C = Critical angle for the material of the prism	 Ray –1 : General emergence $A< 2C$ and Ray – 2: Grazing emergence $A = 2C$ and Ray – 3: TIR $A> 2C$ and

Note: For the condition of grazing emergence. Minimum angle of incidence

$$i_{min} = \sin^{-1}\left[\sqrt{\mu^2 - 1}\,\sin A - \cos A\right]$$

(5) Dispersion through a prism

The splitting of white light into its constituent colors is called dispersion of light.



(i) Angular dispersion (θ): Angular separation between extreme colors i.e.
$\boldsymbol{\theta = \delta_V - \delta_R = (\mu_V - \mu_R)A}$. It depends upon μ and A.

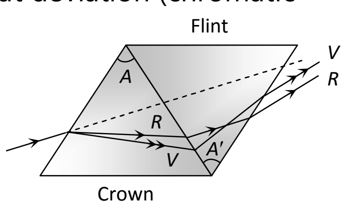
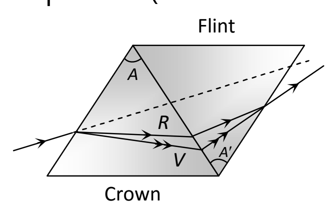
(ii) Dispersive power (ω): $\omega = \dfrac{\theta}{\delta_y} = \dfrac{\mu_V - \mu_R}{\mu_y - 1} \quad \text{where} \left\{ \mu_y = \dfrac{\mu_V + \mu_R}{2} \right\}$

⇒ It depends only upon the material of the prism i.e. μ and it doesn't depends upon angle of prism A

Note: Remember $\omega_{\text{Flint}} > \omega_{\text{Crown}}$.

(6) Combination of prisms

Two prisms (made of crown and flint material) are combined to get either dispersion only or deviation only.

Dispersion without deviation (chromatic combination) 	Deviation without dispersion (Achromatic combination) 
(i) $\dfrac{A'}{A} = -\dfrac{(\mu_y - 1)}{(\mu'_y - 1)}$	(i) $\dfrac{A'}{A} = -\dfrac{(\mu_V - \mu_R)}{(\mu'_V - \mu'_R)}$
(ii) $\theta_{\text{net}} = \theta\left(1 - \dfrac{\omega'}{\omega}\right) = (\omega\delta - \omega'\delta')$	(ii) $\delta_{\text{net}} = \delta\left(1 - \dfrac{\omega}{\omega'}\right)$