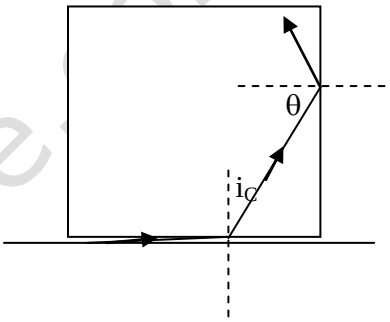
Question 4: A cube of flint glass sits on a newspaper on a table. By looking into one of the vertical sides of the cube, is it possible to see the portion of the newspaper covered by the glass? (Refractive index of flint glass is μ = 1.69)

The problem is based on the phenomenon of total internal reflection. When light is going from denser to rarer medium it bents away from the normal and hence the angle of refraction is grater then angle of incidence. When angle of incident is greater than a certain value, light will totally reflected back in the same medium without getting any refracted part. This phenomenon is called total internal reflection and the maximum angle of incidence for which refraction takes is called critical angle denoted by i_C. When the angle of incidence is just near the critical the angle of refraction will be 900 and hence if μ is the refractive index of the denser medium relative to rarer medium we have by using Snell's law

$$\frac{1}{\mu} = \frac{\sin i_C}{\sin 90^0}$$



Gives $\sin i_C = \frac{1}{\mu}$

Now a thin layer of air may be there between the cube and newspaper at some point and hence first light ray will refracted from air to glass. In any case The maximum angle of incident can be 90^0 for grazing incidence and hence angle of refraction in the glass is give by using Snell's law as

$$\mu = \frac{\sin i}{\sin r}$$

Or $1.69 = \frac{\sin 90^0}{\sin r}$

Or $\sin r = \frac{1}{1.69} = 0.592$

Gives r = 36.2^0

With this minimum angle of incidence at the side face will be

$\theta = 90^0 - 36.28^0 = 53.72^0$

As at the side faces light is going from glass to air means denser to rarer medium, and this minimum angle of incidence is grater critical angle 36.2^0, light will suffer total internal reflection and hence there will be no light will come out from the side faces.

Hence we cannot see any portion of newspaper from the side faces.