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[Derivations In Physics Class 12 Cbse Pdf 395](#)

IMPORTANT DERIVATIONS

(3 marks derivations)

1. Derive the mirror formula for concave mirror.

Let, P = pole and F=principal focus. Object AB is placed beyond C and the real image formed by it is A'B' between F and C.

From similar triangles A'B'C and ABC

$$\frac{AB}{A'B'} = \frac{BC}{B'C} \dots (1)$$

From similar triangles A'B'F and DNF

$$\frac{DN}{A'B'} = \frac{FN}{B'F} \quad \text{or} \quad \frac{AB}{A'B'} = \frac{FN}{B'F} \dots (2)$$

From (1) and (2)

$$\frac{BC}{B'C} = \frac{FN}{B'F} = \frac{FP}{B'F}$$

$$\text{Or, } \frac{PB-PC}{PC-PB'} = \frac{FP}{PB'-PF} \quad (\because \text{the aperture is small, FN=FP})$$

Using sign convention, the above equation can be written as

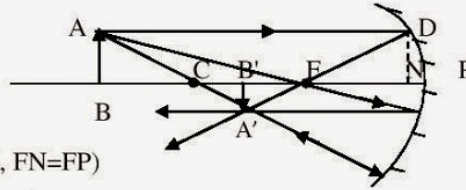
$$\frac{-u-(2f)}{-2f-(-v)} = \frac{-f}{-v-(-f)}$$

$$\text{Or, } 2f^2 - vf = -uf + uv + 2f^2 - 2fv$$

$$\text{Or, } fv + uf = uv$$

Dividing both sides by uvf, we get

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u} \quad \text{which is the required formula.}$$



2. Show that refractive index = real depth/apparent depth.

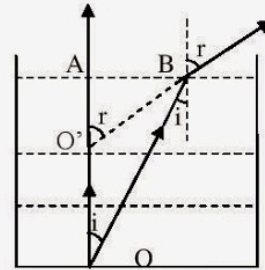
'O' is the object lying at the bottom of a tank containing water.

O' is its virtual image.

$$\text{From Snell's law, } {}^w n_a = \frac{\sin i}{\sin r} = \frac{AB/BO}{AB/BO'} = \frac{BO'}{BO}$$

Since the aperture of the eye is very small, the two rays from A and B will enter the eye, only if B lies very close to A. Then, $BO' \approx AO'$ and $BO \approx AO$.

$$\therefore {}^a n_w = 1 / {}^w n_a = \frac{AO}{AO'} = \frac{\text{Real depth}}{\text{Apparent depth}}$$



3. Derive the relation between critical angle and refractive index of the medium.

When a ray of light passes through denser (water) to a rarer (air) medium, then, according to Snell's law,

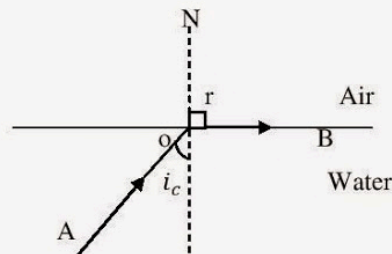
$${}^w n_a = \frac{\sin i}{\sin r}$$

when, $i = i_c$, $r = 90^\circ$

$$\therefore {}^w n_a = \frac{\sin i_c}{\sin 90^\circ} = \sin i_c$$

$$\text{Or, } {}^a n_w = \frac{1}{\sin i_c}$$

$$** \text{ In general, } n = \frac{1}{\sin i_c}$$



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