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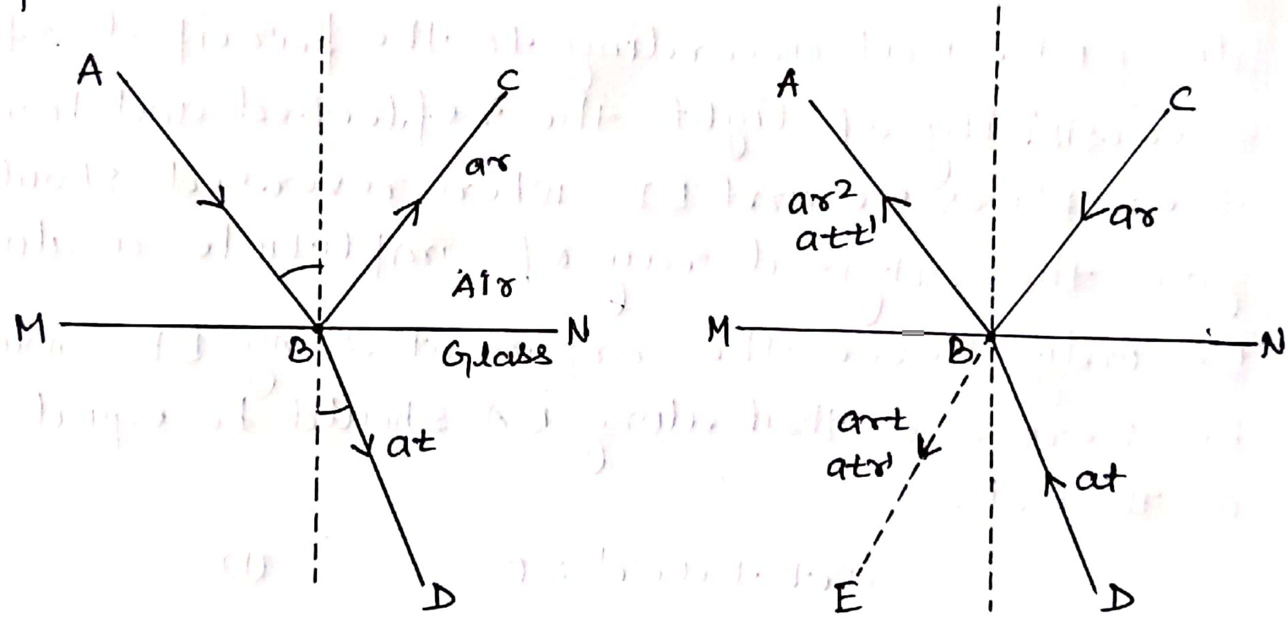
B.Sc (Part-II) Hons

Stoke's theorem for division of amplitude of light.

When a light wave is reflected at the surface of an optically denser medium, it suffers a phase change of π. No such change is introduced, when the reflection takes place at the surface of a rarer medium.



Let MN be the surface of separation of two media the lower one being denser. An incident light wave AB is partly reflected along BC and partly transmitted along BD. Let r be the fraction of the amplitude reflected and t the fraction transmitted when the wave is travelling from rarer to denser medium. Then the amplitudes along BC and BD are ar and at respectively.

Now, suppose the direction of the reflected and transmitted wave are reversed. The wave BC, on reversal give a reflected wave of amplitude ar^2 along BA, and a transmitted wave of amplitude art along BE. Let r' and t' be fractions of amplitude reflected and transmitted when the wave is travelling from denser to rarer medium. Then the wave BD, on reversal, gives a transmitted wave of amplitude att' and BE, and a reflected wave of amplitude atr' along BE. But according to the principal of reversibility of light, the reflected and transmitted waves BC and BD, when reversed should give the original ray of amplitude a along BA only. Hence the component along BE should be zero and that along BA should be equal to a. That is

$$art + atr' = 0 \quad \text{——— (1)}$$

$$art = -atr'$$

$$\therefore r = -r'$$

$$\therefore r' = -r \quad \text{——— (2)}$$

and

$$ar^2 + att' = a \quad \text{——— (3)}$$

$$r^2 + tt' = 1$$

$$\therefore tt' = 1 - r^2 \quad \text{——— (4)}$$

The negative sign in eqn (2) indicates displacement in opposite direction. i.e. a phase change of π either at reflection from rarer to denser medium or at reflection from denser to rarer medium.