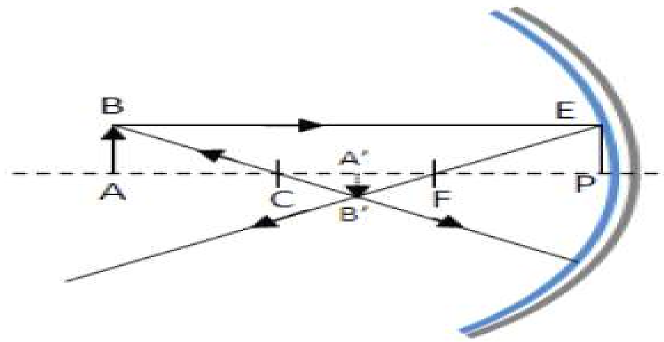
CBSE Class 10th Physics : Derivation or Proof of Mirror

Derivation or Proof-of-Mirror formula(X) physics:

Mirror formula is the relationship between object distance (u), image distance (v) and focal length.

$$1/v + 1/u = 1/f$$



In Δ ABC and A'B'C

<A = <A' = 90^0

<C =<C (vert. opp. <s]

ΔABC ~ΔA'B'C [AA similarity]

AB /A'B' = AC/A'C ----(I)

Similarly,

In Δ ABC and A'B'C

<A = <A' = 90^0

<C =<C (vert. opp. <s]

ΔABC ~ΔA'B'C [AA similarity]

AB /A'B' = AC/A'C ----(1)

Similarly, In ΔFPE ~ A'B'F

EP /A'B' = PF/A'F

AB /A'B' = PF/A'F [AB=EP] ----(II)

From (i) &(ii)

AC/A'C = PF/A'F

$\Rightarrow$ A'C/AC = A'F/PF

$\Rightarrow$(CP-A'P)/(AP- CP) = (A'P – PF)/PF

Now, PF = -f ; CP = 2PF = -2f ;

AP = -u ; and A'P = -v

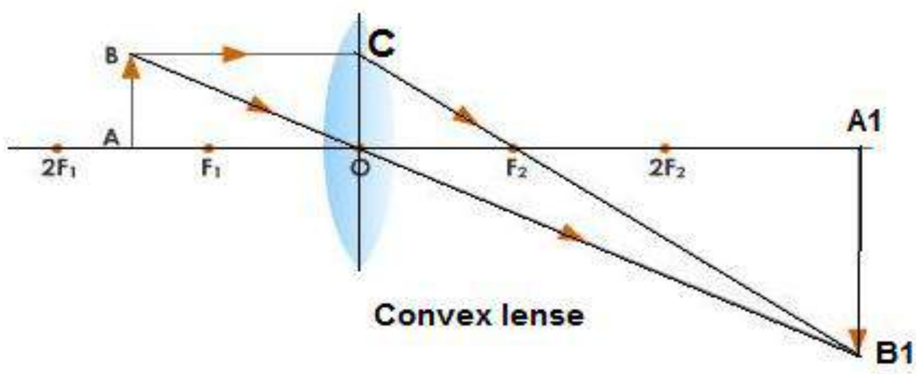
Put these value in above relation:

$[(-2f) - (-v)] / (-u) - (-2f) = \{(-v) - (-f)\} / (-f)$

$\Rightarrow uv = fv + uf$

$\Rightarrow 1/f = 1/u + 1/v$

Derivation or Proof-of- Lens formula(X) physics



Let AB is an object placed between f1 and f2 of the convex lens. The image A1B1 is formed beyond $2F_2$ and is real and inverted.

OA = Object distance = u ; OA1 = Image distance = v ; OF_2 = Focal length = f

In ΔOAB and ΔOA_1B_1 are similar

$<BAO = <B_1A_1O = 90^0$

$<AOB = <A_1OB_1$ [vertically opp. <s]

$\Delta OAB \sim \Delta OA_1B_1$

$A_1B_1 / AB = OA_1/OA$ -------------------(i)

Similarly, $\Delta OCF_2 \sim \Delta F_2A_1B_1$

$A_1B_1 / OC = F_2A_1/OF_2$

But we know that OC = AB

$\Rightarrow A_1B_1 / AB = F_2A_1/OF_2$ -------------------(ii)

From equation (i) and (ii), we get

$OA_1/OA = F_2A_1/OF_2$

$OA_1/OA = (OA_1 - OF_2)/OF_2$

$v/-u = (v-u)/f$

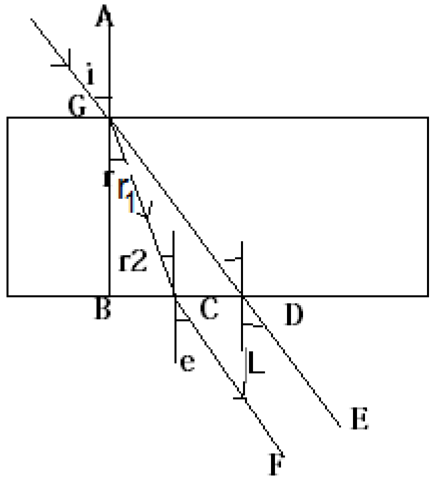
$vf = -u(v-f)$

$vf = -uv + uf$

Dividing equation (3) throughout by uvf

$1/v - 1/u = 1/f$

Prove that while refraction through a rectangular glass slab the incident ray is parallel to the emergent ray



In triangle GBC,

$r1 + 90 - r2 = 90$ [*Angle sum properties of triangle*]

$r1 = r2$..........................(i)

$Now\ refractive\ index\ of\ glass = sin\ i/sin\ r1 = sin\ e/sin\ r2$...................$(ii)$

$as\ r1 = r2 \quad from\ (i)$

$so < i =< e$ iii

$Now\ as\ the\ incident\ ray\ is\ extended\ till\ E, < LDE\ \ should\ be\ equal\ to < i.$

For, CF and DE, and transversal CD , < BCF = (90 + e) and < CDE = (90 + i)

Since these are corresponding angle, CF will be parallel to DE.