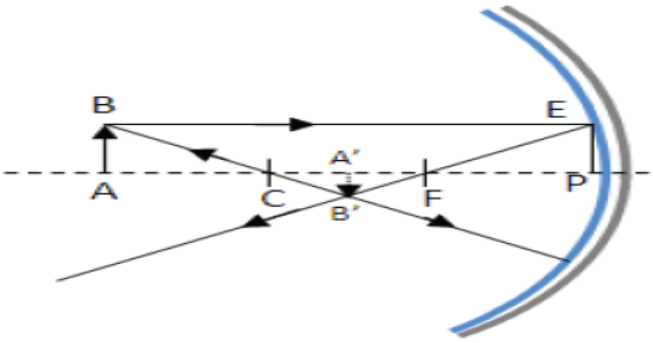
CBSE Class 10th Physics : Derivation or Proof of Mirror

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

⇒ A'C/AC = A'F/PF

⇒(CP-A'P)/(AP- CP) = (A'P – PF)/PF

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

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

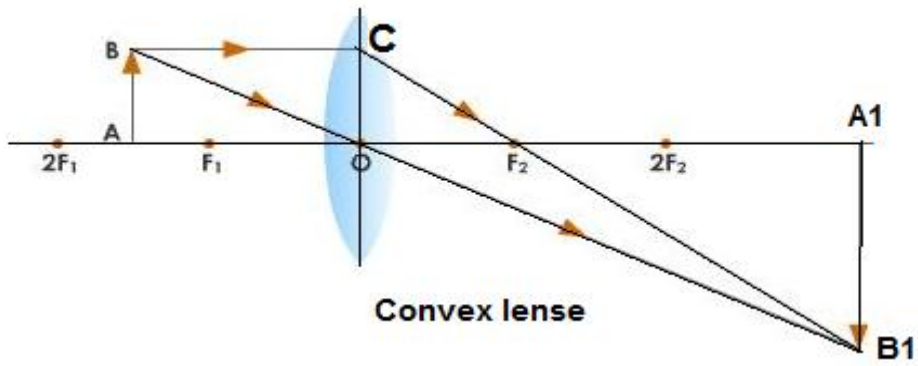
Put these value in above relation:

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

⇒ uv = fv +uf

⇒ 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

⇒ $A_1B_1 /AB = F_2A_1/OF_2$ ----------(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