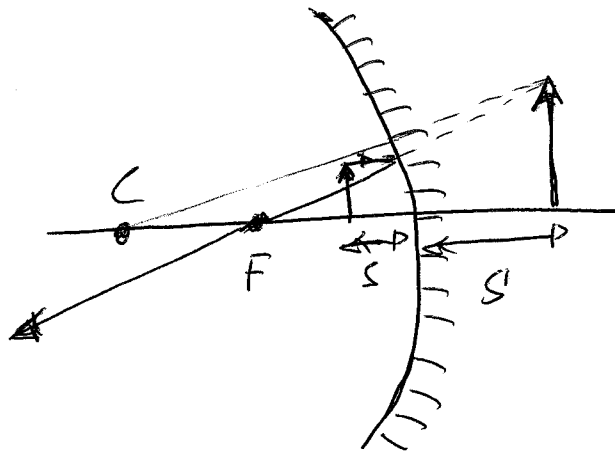


$$\Delta.- \quad \frac{1}{s'} + \frac{1}{s} = \frac{1}{f} \Rightarrow$$

$$s = -8 \text{ cm} \quad ; \quad s' = +10 \text{ cm} \Rightarrow f = ?$$

$$f = \frac{1}{\frac{1}{10 \text{ cm}} + \frac{1}{-8 \text{ cm}}} = -40 \text{ cm}$$



$$y' = -y \frac{s'}{s}$$

$$y' = -3 \text{ cm} \frac{10 \text{ cm}}{-8 \text{ cm}} = 3.75$$

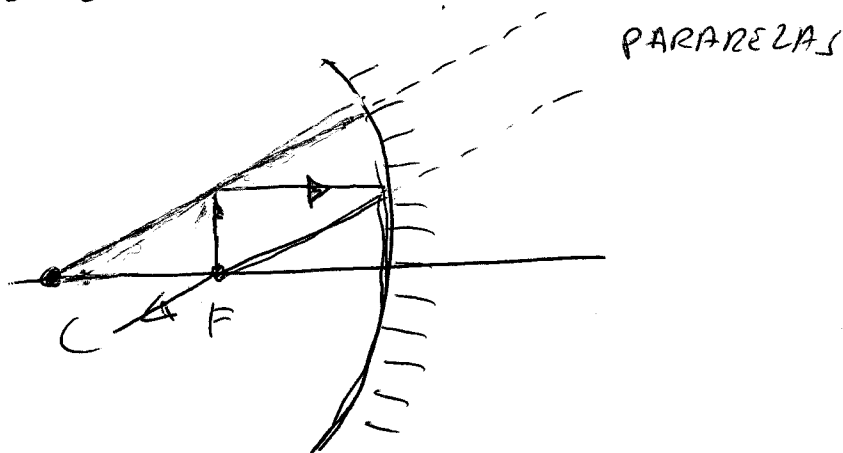
c)

$$s' = \frac{1}{\frac{1}{f} - \frac{1}{s}} \quad ; \quad \text{CANDO HAI INDETERMINAÇÃO}$$

$$s = f.$$

$$s' = \frac{1}{\frac{1}{f} - \frac{1}{f}} = \infty$$

GRAFICAMENTE



2.-

$$y = 3\text{cm.}$$

$$s = -75\text{cm.}$$

↑
a esquerda.

$$s' = +37.5\text{cm}$$

↑
a direita

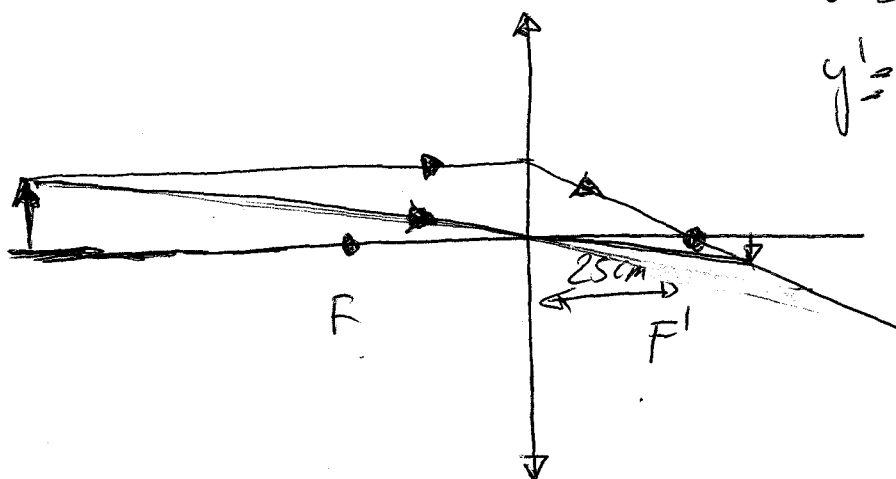
$$\frac{1}{s'} - \frac{1}{s} = \frac{1}{f'} ; \beta = \frac{s'}{s} = \frac{y'}{y}$$

$$f' = \frac{1}{\frac{1}{s'} - \frac{1}{s}}$$

$$f' = \frac{1}{\frac{1}{37.5\text{cm}} - \frac{1}{(-75\text{cm})}} ; f' = 25\text{cm.}$$

$$y' = y \frac{s'}{s} = 3\text{cm} \frac{37.5\text{cm}}{(-75\text{cm})}$$

$$y' = -1.5\text{cm}$$



MEIOR
INVERTIDA
DIREITA.

3.-

a)

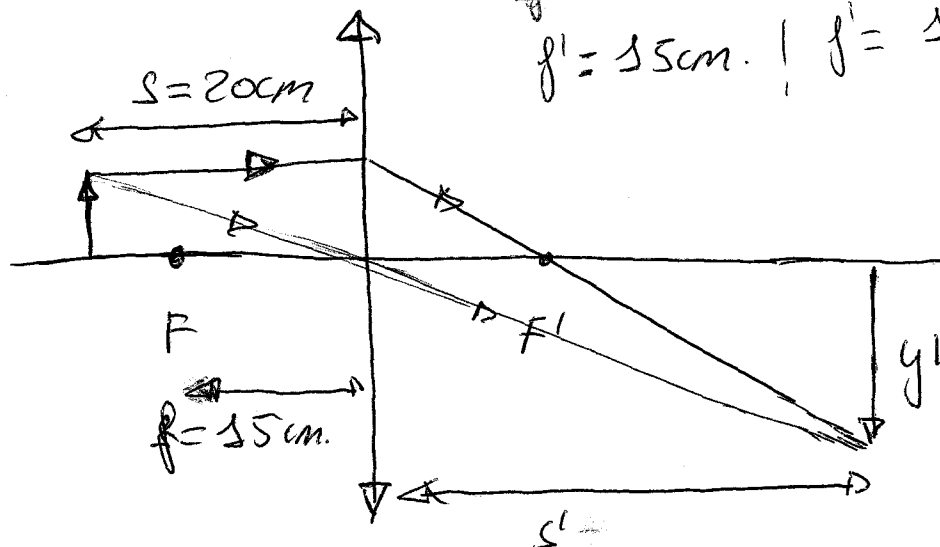
Enunciado →

$$s = 20\text{cm.} \quad | \quad s' = -20\text{cm}$$

$$f = 15\text{cm.} \quad | \quad f' = 15\text{cm.}$$

INVERTIDA.
REAL
MAIOR

$$y = 3\text{cm.}$$



$$\frac{1}{s'} - \frac{1}{s} = \frac{1}{f'} \quad y' = y \frac{s'}{s}$$

$$s' = \frac{1}{\frac{1}{f'} + \frac{1}{s}} = \frac{1}{\frac{1}{15\text{cm}} + \frac{1}{(-20\text{cm})}} = 60\text{cm} (+60\text{cm})$$

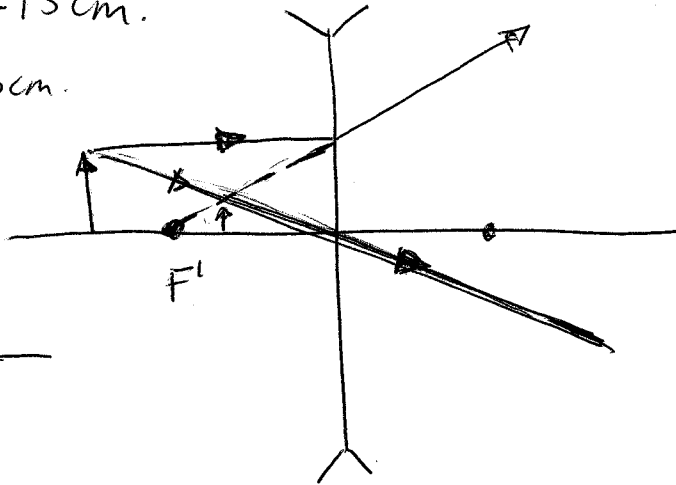
$$y' = 3\text{cm} \cdot \frac{60\text{cm}}{-20\text{cm}} = -9\text{cm}.$$

b)

$$s = 20\text{cm}$$

$$f' = -15\text{cm}.$$

$$y = 3\text{cm}.$$



DEREITA.
VIRTUAL.
MENOR.

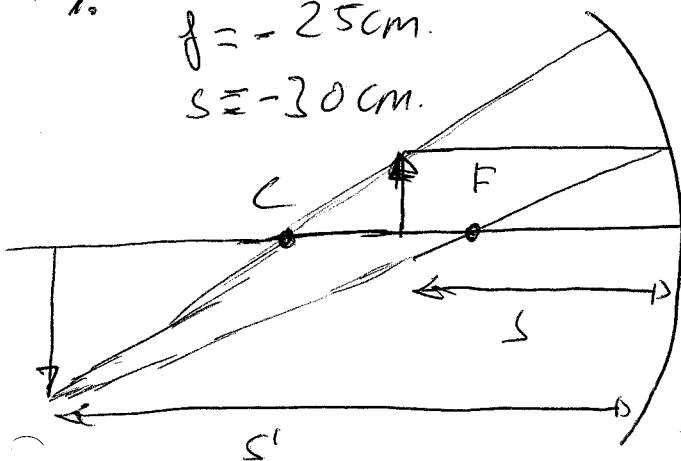
$$s' = \frac{1}{\frac{1}{f'} + \frac{1}{s}}$$

$$s' = \frac{1}{\frac{1}{-15\text{cm}} + \frac{1}{-20\text{cm}}} = -8.5\text{cm} \quad ; \quad y' = 3\text{cm} \cdot \frac{-8.5\text{cm}}{-20\text{cm}} = 1.28\text{cm}.$$

- 4. -

$$f = -25\text{cm}.$$

$$s = -30\text{cm}.$$



INVERTIDA
REAL
MAIOR

$$\frac{1}{s'} + \frac{1}{s} = \frac{1}{f} \quad ; \quad s' = \frac{1}{\frac{1}{f} - \frac{1}{s}}$$

$$s' = \frac{1}{\frac{1}{(-25\text{cm})} - \frac{1}{(-30\text{cm})}} = -150\text{cm}.$$

$$y' = -y \frac{s'}{s} = -5\text{cm} \cdot \frac{-150\text{cm}}{-30\text{cm}} = -25\text{cm}.$$

(3)

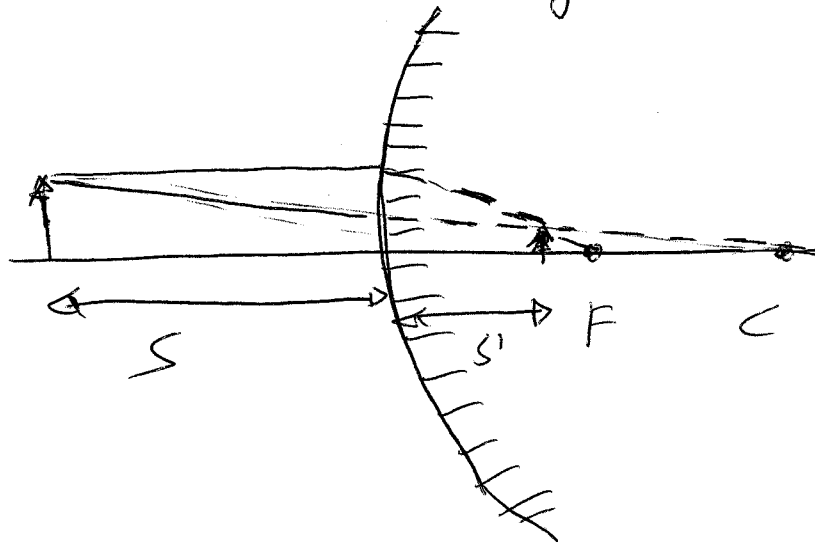
6)

$$f = +25 \text{ cm}$$

$$s = -30 \text{ cm}$$

$$y = 5 \text{ cm}$$

DEREITA
VIRTUAL.
MENOR

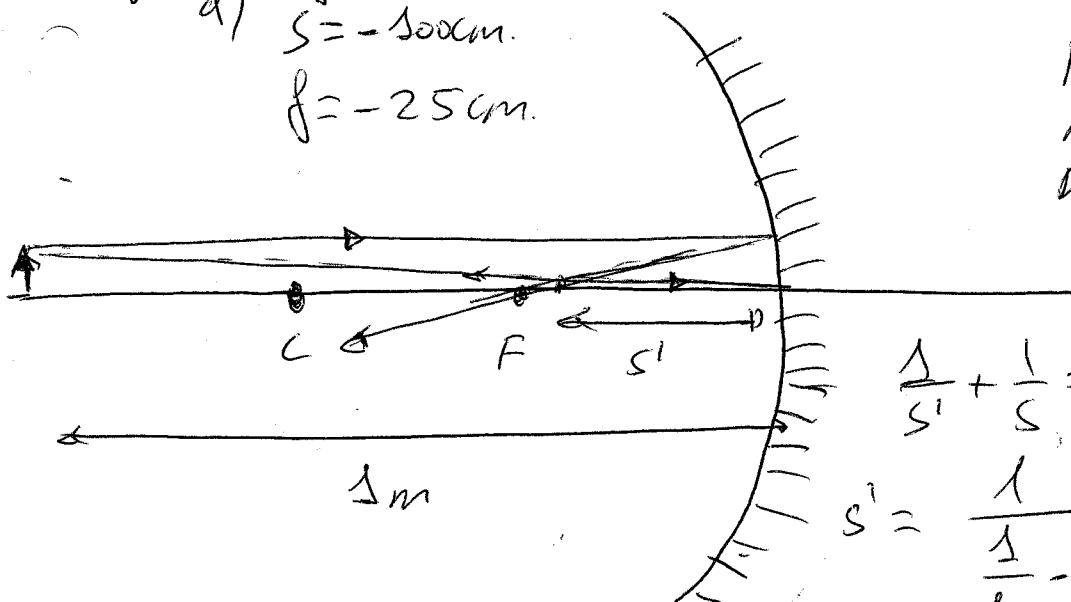


$$\frac{1}{s'} + \frac{1}{s} = \frac{1}{f} \quad \text{then} \quad s' = \frac{1}{\frac{1}{f} - \frac{1}{s}}; \quad s' = \frac{1}{\frac{1}{25 \text{ cm}} - \frac{1}{(-30 \text{ cm})}}$$

$$s' = 13'6 \text{ cm} \quad y' = -y \frac{s'}{s} = -5 \text{ cm} \frac{13'6 \text{ cm}}{(-30 \text{ cm})} = 2'27 \text{ cm}$$

5 - d) $y = 5 \text{ cm}$
 $s = -100 \text{ cm}$
 $f = -25 \text{ cm}$

MENOR
REAL.
DEREITA.



$$\frac{1}{s'} + \frac{1}{s} = \frac{1}{f}$$

$$s' = \frac{1}{\frac{1}{f} - \frac{1}{s}} = \frac{1}{\frac{1}{-25 \text{ cm}} - \frac{1}{(-100 \text{ cm})}}$$

$$s' = -33'3 \text{ cm}$$

$$y' = -y \frac{s'}{s} = -5 \text{ cm} \frac{-33'3 \text{ cm}}{-100 \text{ cm}} = -0'96 \text{ cm}; \quad A = \frac{-33'3 \text{ cm}}{-100 \text{ cm}}$$

b)

$$f = -25 \text{ cm}$$

$$s = -30 \text{ cm}$$

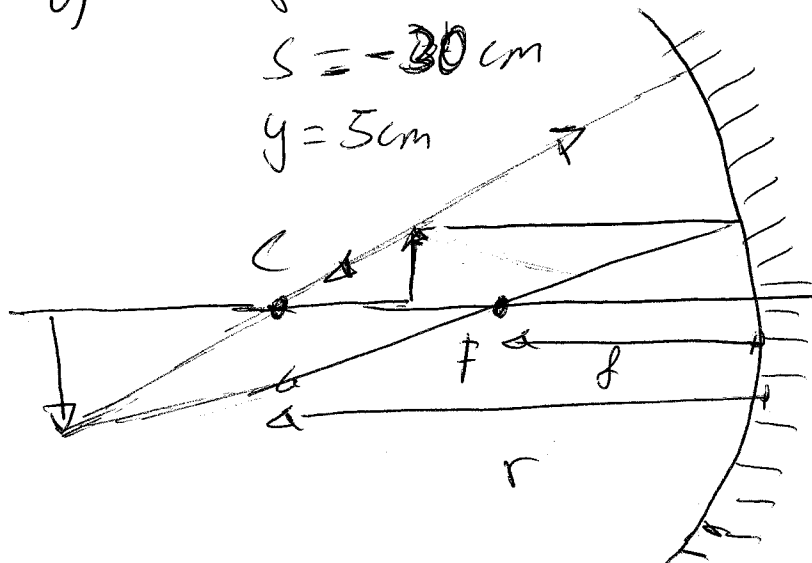
$$y = 5 \text{ cm}$$

IMAGEN

INVERTIDA

REAL

MAIOR



$$\frac{1}{s'} + \frac{1}{s} = \frac{1}{f}$$

$$A = \frac{y'}{y} = -\frac{s'}{s}$$

$$s' = \frac{1}{\frac{1}{f} - \frac{1}{s}}$$

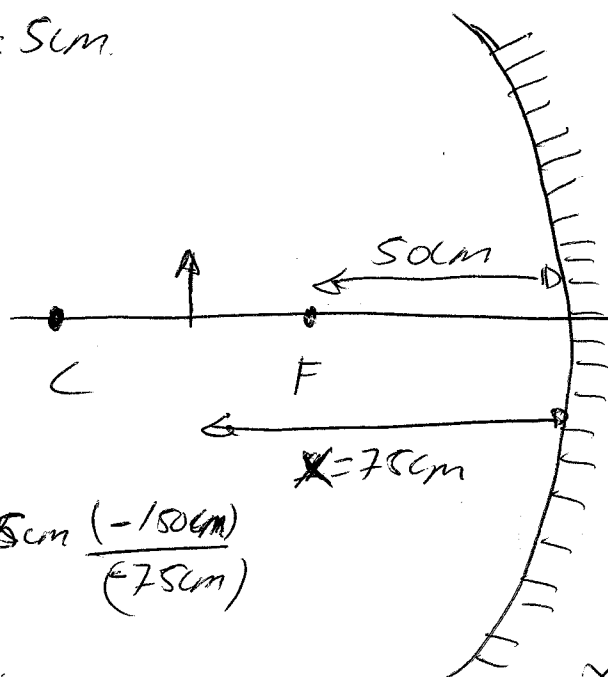
$$\text{2o } s' = \frac{1}{\frac{1}{(-25 \text{ cm})} - \frac{1}{(-30 \text{ cm})}}$$

$$s' = -150 \text{ cm}$$

$$A = -\frac{s'}{s} = -\frac{(-150 \text{ cm})}{(-30 \text{ cm})} = -5$$

6.-

a) $y = 5 \text{ cm}$



$$\frac{1}{x'} + \frac{1}{x} = \frac{1}{f}$$

$$x' = \frac{1}{\frac{1}{f} - \frac{1}{x}}$$

$$x' = \frac{1}{\frac{1}{(-25 \text{ cm})} - \frac{1}{(-30 \text{ cm})}}$$

$$x' = \frac{1}{\frac{1}{(-50 \text{ cm})} - \frac{1}{(-75 \text{ cm})}}$$

$$x' = -150 \text{ cm}$$

(5)

$$y' = -y \frac{s'}{s} = -5 \text{ cm} \frac{(-150 \text{ cm})}{(-75 \text{ cm})}$$

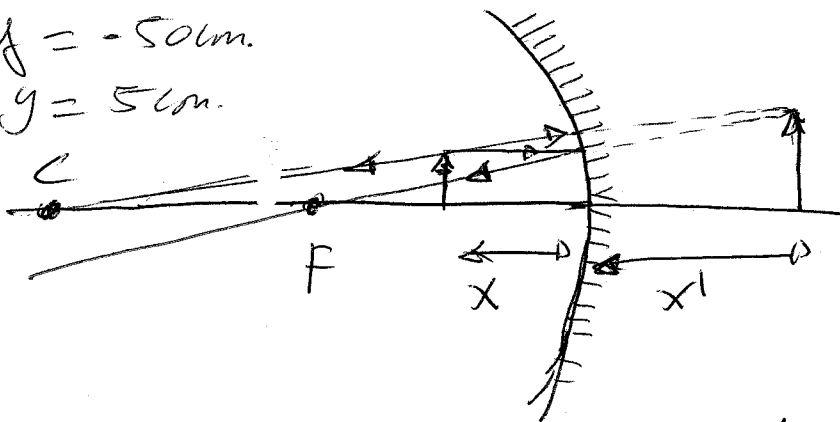
$$y' = -10 \text{ cm}$$

6. - apartado b)

$$x = -25\text{cm}$$

$$y = -50\text{cm}$$

$$y = 5\text{cm}$$



DEREITA
VIRTUAL
MAIOR

$$x' = \frac{1}{\frac{1}{f} - \frac{1}{x}} ; x' = \frac{1}{\frac{1}{(-50\text{cm})} - \frac{1}{(-25\text{cm})}} = 50\text{cm}$$

$$y' = -y \frac{x'}{x} = -5\text{cm} \frac{50\text{cm}}{(-25\text{cm})} = -10\text{cm}$$

7. -

$$y = 5\text{cm}$$

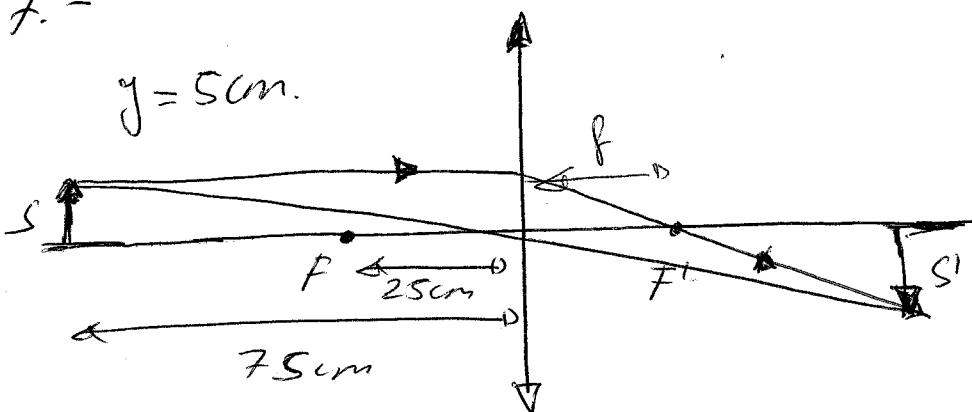


IMAGEM:
INVERTIDA
REAL
MAIOR?

$$s' = \frac{1}{\frac{1}{s'} - \frac{1}{s}} = \frac{1}{\frac{1}{f'}} = \frac{1}{\frac{1}{25\text{cm}} + \frac{1}{-75\text{cm}}}$$

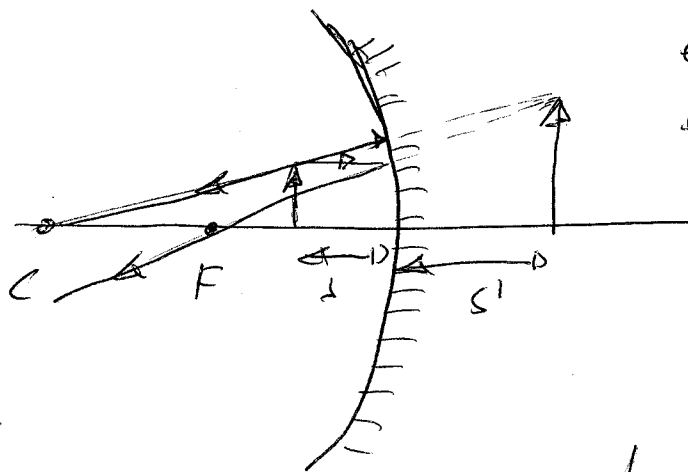
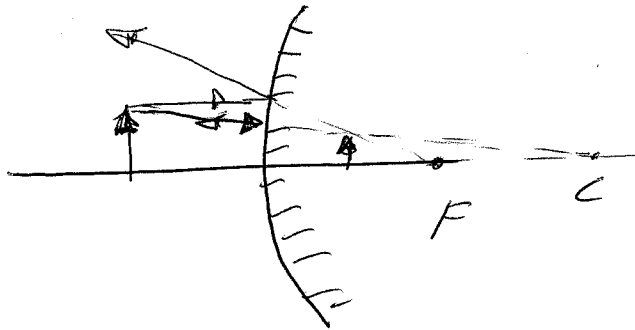
$$s' = 37.5\text{cm}$$

$$y' = -y \frac{s'}{s} = 5\text{cm} \frac{37.5\text{cm}}{75\text{cm}} = 2.5\text{cm}$$

8.-

espelho $\begin{cases} P \text{ Concauo} \\ D \text{ convexo?} \end{cases}$

convexo $\Rightarrow$ IMAXO MENOR



espelho concauo
e o objecto
drente do plo

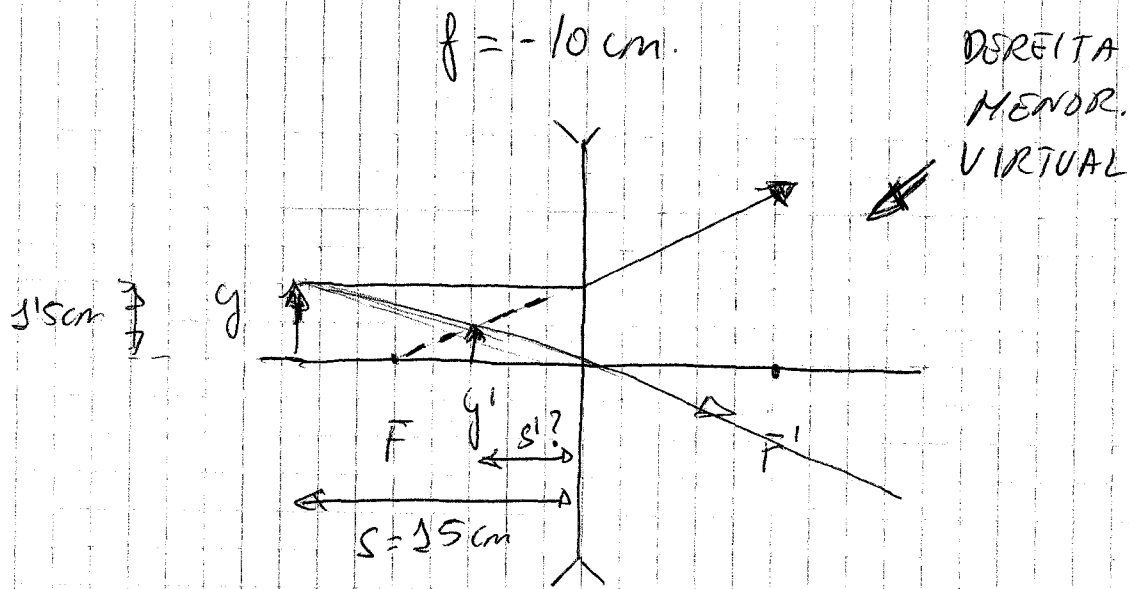
$S = -10 \text{ cm.}$

$\frac{y'}{y} = 2. \Rightarrow S' = +20 \text{ cm.} \Rightarrow \frac{1}{S'} + \frac{1}{S} = \frac{1}{f}$

$$f = \frac{1}{\frac{1}{S'} + \frac{1}{S}} = \frac{1}{\frac{1}{20 \text{ cm}} + \frac{1}{-10 \text{ cm}}} = -20 \text{ cm}$$

$r = 2f = -40 \text{ cm.}$

9.-



$$\frac{1}{s'} - \frac{1}{s} = \frac{1}{f} \Rightarrow \frac{1}{s'} = \frac{1}{f} + \frac{1}{s} \Rightarrow s' = \frac{1}{\frac{1}{f} + \frac{1}{s}}$$

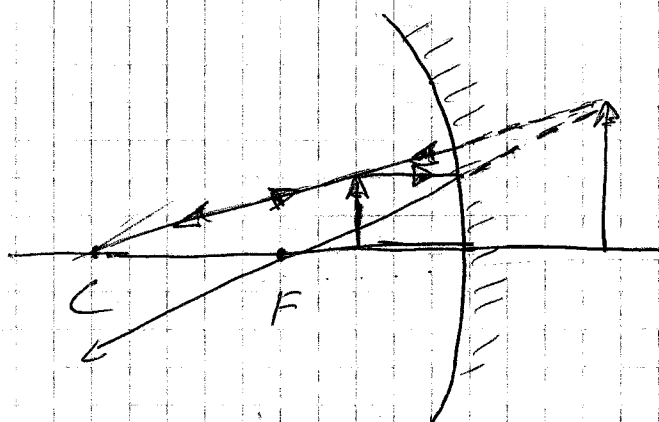
$$s' = \frac{1}{\frac{1}{-10 \text{ cm}} + \frac{1}{-15 \text{ cm}}} \quad s' = -6 \text{ cm.}$$

$$\beta = \frac{y'}{y} = \frac{s'}{s} \Rightarrow y' = y \frac{s'}{s} = 1.5 \text{ cm.} \frac{(-6 \text{ cm})}{(-15 \text{ cm})}$$

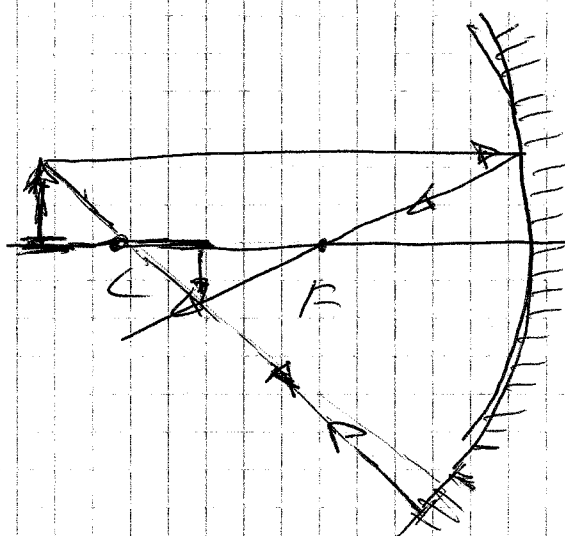
$$y' = 0.6 \text{ cm}$$

c) now.

50.-

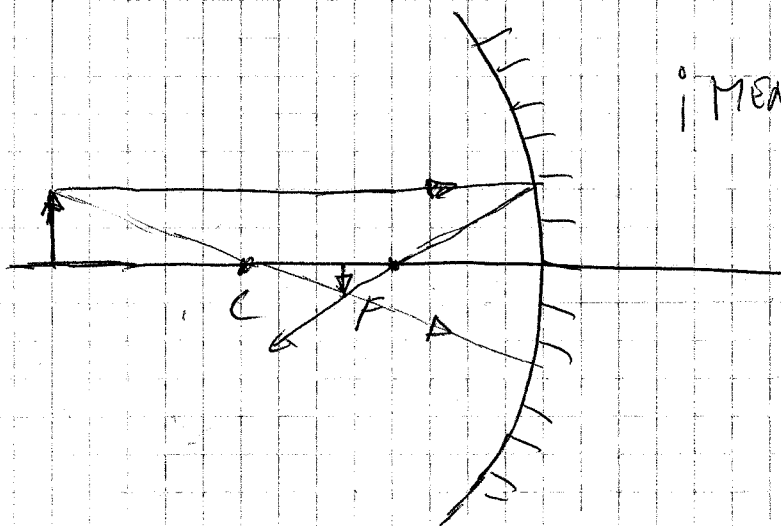


DEREITA
MAIOR
VIRTUAL

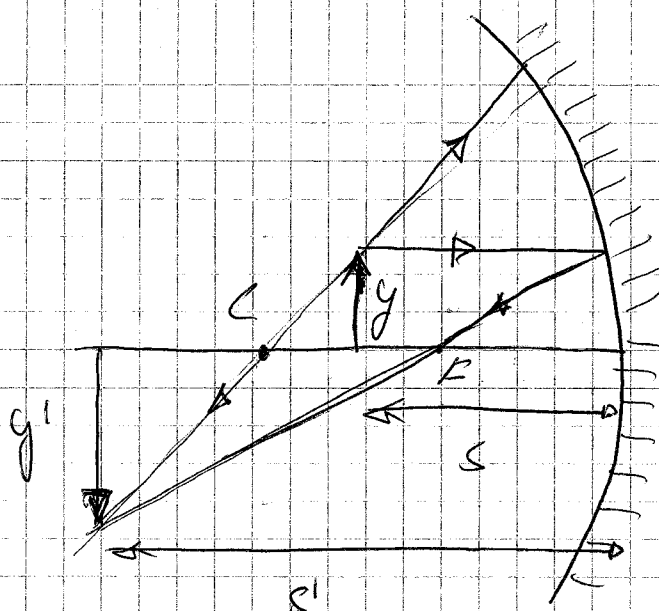


MEHOR ?

AMPLIAR A DISTANCIA



MEHOR !



MAIOR

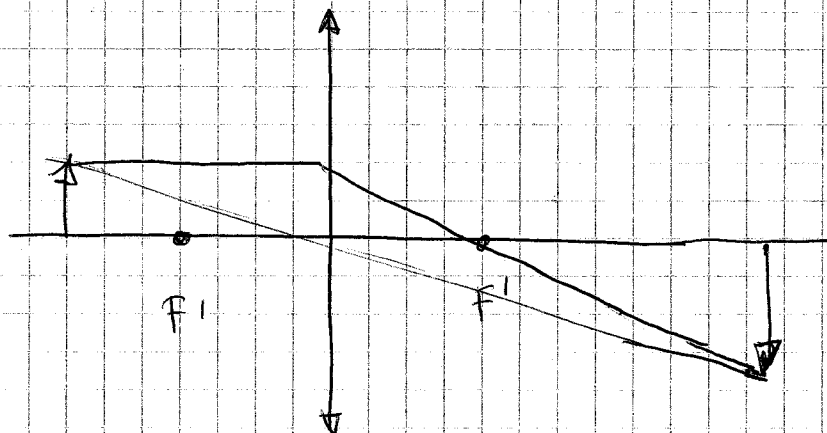
$$\frac{y'}{y} = -\frac{s'}{s} \quad \frac{1}{s'} + \frac{1}{s} = \frac{1}{f}$$

$$|y'| = |2y| \quad \text{CUIDADO} \quad |s'| = |2s|$$

$$\frac{1}{2s} + \frac{1}{s} = \frac{1}{f} \Rightarrow \frac{3}{2s} = \frac{1}{f}$$

$$s = \frac{3}{2}f; \quad s = \frac{3}{2} \left(-\frac{15\text{cm}}{2} \right) = -11,25\text{cm}$$

b)



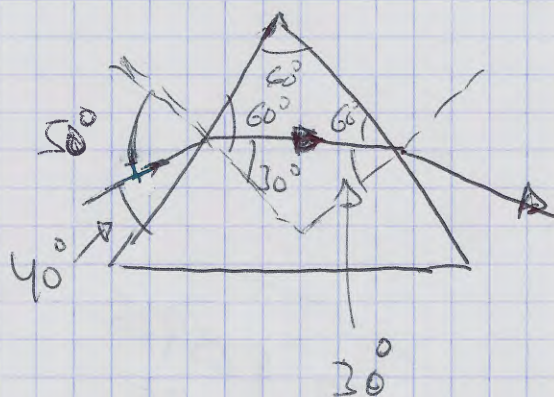
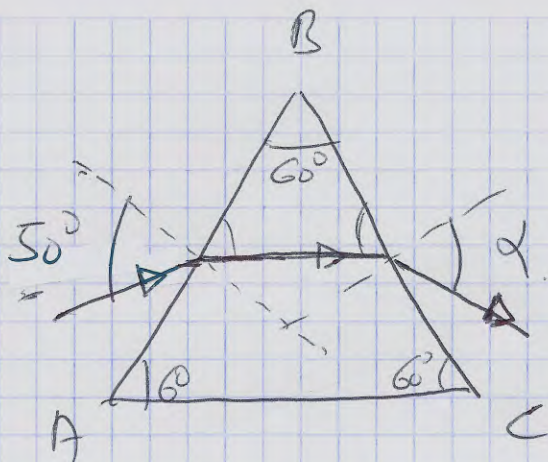
$$|y'| = |2y|$$

$$s' = |2s|$$

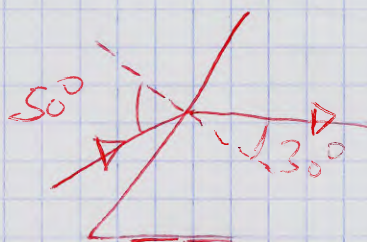
$$\frac{1}{f'} = \frac{1}{s'} + \frac{1}{s}; \quad \frac{1}{f'} = \frac{1}{2s} + \frac{1}{s}; \quad \frac{1}{f'} = \frac{3}{2s} \Rightarrow s = \frac{3}{2}f'$$

$$s = \frac{3}{2} 7,5\text{cm} = 11,25\text{cm}; \quad \text{com sinal} \quad s = -11,25\text{cm}$$

22.-



FACENDO UMA PARTE

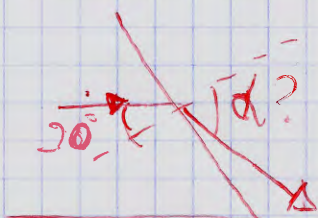


$$\frac{\sin i}{\sin r} = \frac{n_{\text{PRISMA}}}{n_{\text{AIRE}}}$$

$$\frac{\sin i}{\sin r} = n_{\text{PRISMA}}$$

$$n_{\text{PRISMA}} = \frac{\sin 50^\circ}{\sin 30^\circ} \Rightarrow n_{\text{PRISMA}} = 1,53$$

A SAÍDA DO RAIO

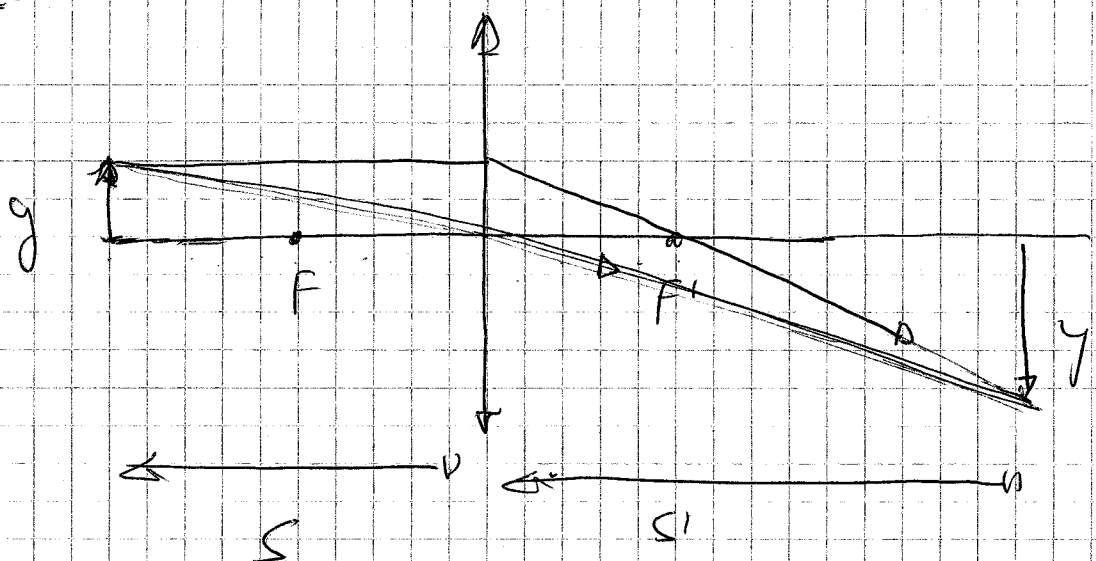


$$\frac{\sin i}{\sin r} = \frac{n_{\text{AIRE}}}{n_{\text{PRISMA}}}, \quad \frac{\sin 30^\circ}{\sin \alpha} = \frac{1}{1,53}$$

$$\alpha = 50^\circ$$

12-

a)



$$y = 3 \text{ cm}$$

$$S = -20 \text{ cm}$$

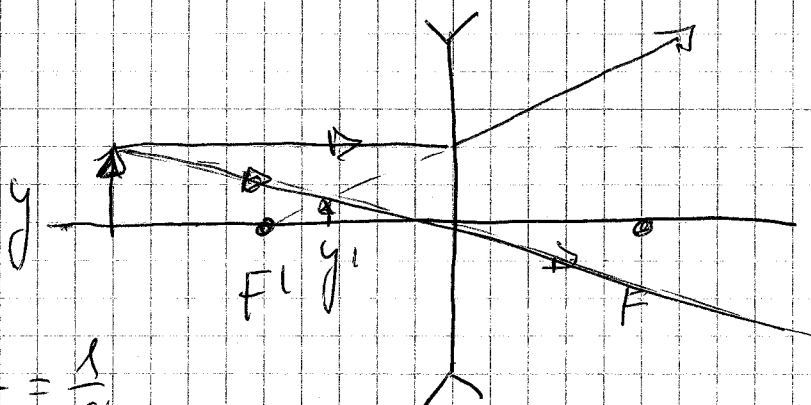
$$f' = +10 \text{ cm}$$

$$\frac{1}{S'} - \frac{1}{S} = \frac{1}{f'} \Rightarrow S' = \frac{1}{\frac{1}{f'} + \frac{1}{S}}$$

$$S' = \frac{1}{\frac{1}{10 \text{ cm}} + \frac{1}{-20 \text{ cm}}} \Rightarrow S' = 20 \text{ cm}$$

$$y' = y \frac{S'}{S} = 3 \text{ cm} \cdot \frac{20 \text{ cm}}{-20 \text{ cm}} = -3 \text{ cm}$$

b)



$$f' = -10 \text{ cm}$$

$$y = 3 \text{ cm}$$

$$S = -20 \text{ cm}$$

$$\frac{1}{S'} - \frac{1}{S} = \frac{1}{f'}$$

$$S' = \frac{1}{\frac{1}{f'} + \frac{1}{S}}; S' = \frac{1}{\frac{1}{-10 \text{ cm}} + \frac{1}{-20 \text{ cm}}} \Rightarrow S' = -6.7 \text{ cm}$$

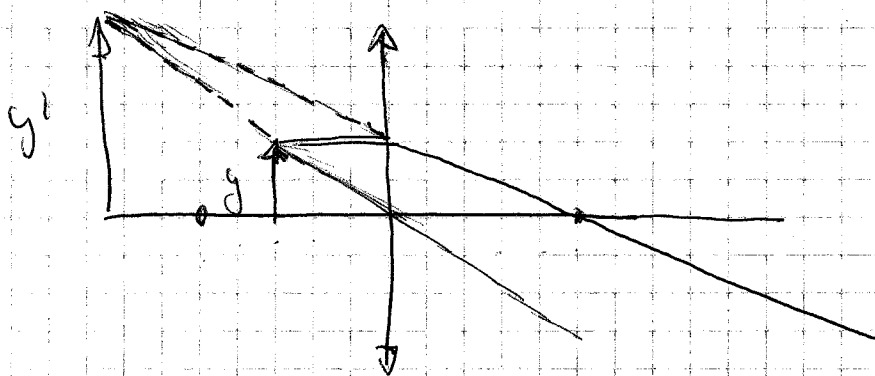
$$y' = y \frac{S'}{S} \Rightarrow y' = 3 \text{ cm} \cdot \frac{-6.7 \text{ cm}}{-20 \text{ cm}} = 1 \text{ cm}$$

13.- ^{??} distancia 2'7m

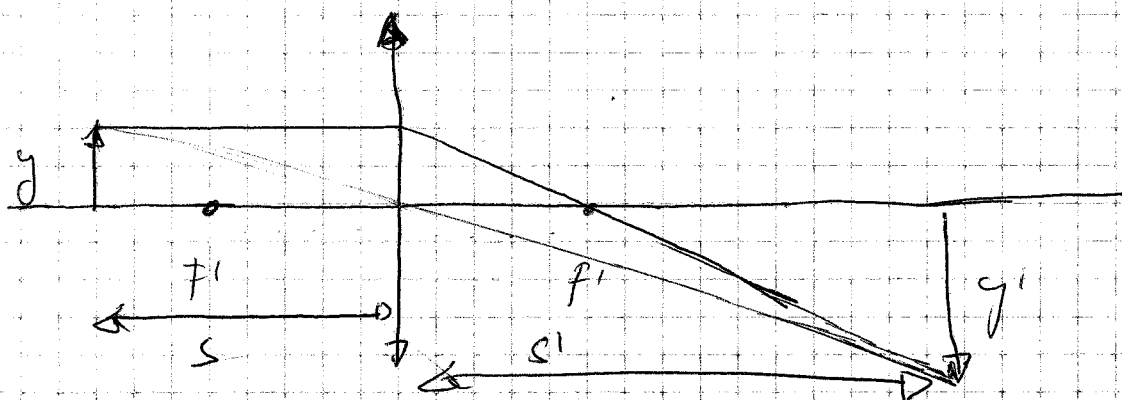
$$\frac{1}{s'} - \frac{1}{s} = \frac{1}{f} \quad \therefore \frac{s'}{s} = \frac{y'}{y}$$

$$|y'| = |10y|$$

$$|s| \geq |f|$$



Imaxe virtual (NON SE PODE RECOLLIR SOBRE UNA PANTALLA)



$$s + s' = 2'7m$$

$$|y'| = |10y| \quad \rightarrow \quad s' = 10s \Rightarrow s + s' = 2'7m \Rightarrow s = 0'25m$$

sen signo $s = -2'45 \cdot 10^{-1} m$; $s' = 2'45m$

$$f' = \frac{1}{\frac{1}{s'} - \frac{1}{s}}; \quad f = \frac{1}{\frac{1}{2'45m} - \frac{1}{-2'45 \cdot 10^{-1}m}} = 2'22 \cdot 10^{-1} m$$

4'49 m