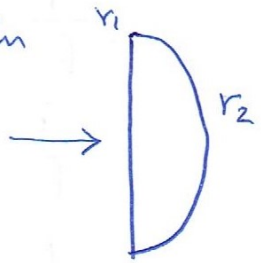
Ex:-

A lens is flat on its front surface and convex with a radius of curvature of 20 cm for the other surface if the lens material has an index of refraction (1.5) Find:- a- it's focal length, b- the image location for an object placed at 50 cm in front of the lens.

$r_1 = \infty$, $r_2 = -20\,cm$, $n = 1.5$, $s = 50\,cm$

$F = ?$, $s' = ?$



Sol:-

a- $$\frac{1}{f} = (n-1)\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$$

$$\frac{1}{f} = (1.5-1)\left(\frac{1}{\infty} - \frac{1}{-20}\right)$$

$$\frac{1}{f} = 0.5\left(0 + \frac{1}{20}\right) = \frac{0.5}{20} = \frac{1}{40} = 0.025$$

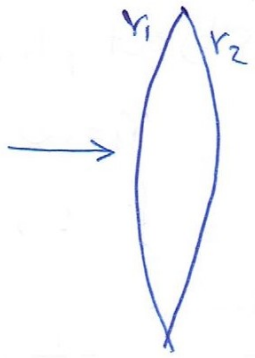
البعد البؤري $f = \frac{1}{0.025} = 40\,cm$

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

موقع الصورة $s' = \frac{sf}{s-f} = \frac{50 \times 40}{50-40} = \frac{2000}{10} = 200\,cm$

Ex2:-

Ex2:- lens of two Convex Surfaces with radii of curvature 0.1m and 0.2m, find the value of it's focal length ($n = 1.5$).



$r_1 = 0.1\,m$, $r_2 = -0.2\,m$

$$\frac{1}{f} = (n-1)\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$$

$$\frac{1}{f} = (1.5-1)\left(\frac{1}{0.1} - \frac{1}{-0.2}\right)$$

$$\frac{1}{f} = 0.5\,(10+5) = 0.5 \times 15 = 7.5$$

$$f = \frac{1}{7.5} = 0.133\,m$$

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Ex3:- A thin lens ($n = 1.5$), has two Convex surfaces

$r_1 = 10\,cm$, $r_2 = 10\,cm$

find the value of the focal length.

$$\frac{1}{f} = (n-1)\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$$

$$\frac{1}{f} = (1.5-1)\left(\frac{1}{10} - \frac{1}{-10}\right)$$

$$= 0.5\left(\frac{1}{10} + \frac{1}{10}\right) = 0.5\left(\frac{2}{10}\right)$$

$$\frac{1}{f} = \frac{2}{20} = \frac{1}{10}$$

$$f = 10\,cm$$

Ex 4:- If you have a thin lens ($n = 1.5$), has a focal length of (30 Cm), the first surface is a flat surface, find the type and the radius of the second surface.

$n = 1.5$, $f = 30$ Cm, $r_1 = \infty$, $r_2 = ??$

Sol.:- $\frac{1}{f} = (n-1)\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$

$\frac{1}{30} = (1.5-1)\left(\frac{1}{\infty} - \frac{1}{r_2}\right) = 0.5\left(0 - \frac{1}{r_2}\right) = 0.5\left(-\frac{1}{r_2}\right)$

$-\frac{1}{r_2} = \frac{\frac{1}{30}}{0.5} = \frac{1}{15}$

$r_2 = -15$ Cm (Convex surface because the negative sign)

Ex 5:- A Certain double Convex thin lens ($n = 1.45$). If the radius of the first surface and the back surface is 23 Cm

a- Find the Value of the Focal length?

$n = 1.45$, $r_1 = 23$ Cm, $r_2 = -23$ Cm, $f = ?$

Sol:-

$\frac{1}{f} = (n-1)\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$

$\frac{1}{f} = (1.45-1)\left(\frac{1}{23} - \frac{1}{-23}\right)$

$f = 25.6$ Cm

b- Find the image distance if an object placed at 120 Cm in front of the lens.

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

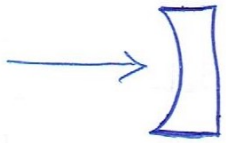
$s' = \frac{sf}{s-f} = \frac{120 \times 25.6}{120 - 25.6} = 32.5$ Cm

EX6:- A Concave flat ~~surface~~ thin lens, the radius of the Concave surface is 12 Cm, and the focal length is 22.2 Cm find the Value of the refractive index

$f = -22.2$ Cm (Concave surface)

$r_1 = -12$ Cm (Concave surface)

$r_2 = \infty$, $n = ??$



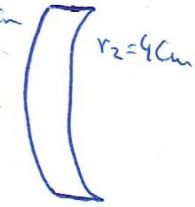
$$\frac{1}{f} = (n-1)\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$$

$$\frac{1}{-22.2} = (n-1)\left(\frac{1}{-12} - \frac{1}{\infty}\right)$$

$$(n-1) = \frac{12}{22.2} = 0.54$$

$$n = 1.54$$

EX7:- A Convex - Concave thin lens, has a radii of Curvature (3,4) Cm, is made up of a glass of ($n = 1.6$), a- find the Value of the focal length b- the lateral magnification if an object is placed at 28 Cm) in front of the lens.



$n = 1.6$, $r_1 = 3$Cm, $r_2 = 4$Cm, $f = ?$, $m = ?$,

$s = 28$ Cm

Sol:-

a-

$$\frac{1}{F} = (n-1)\left(\frac{1}{r_1} - \frac{1}{r_2}\right) = (1.6-1)\left(\frac{1}{3} - \frac{1}{4}\right)$$

$$= 0.6\left(\frac{4-3}{12}\right) = 0.6\left(\frac{1}{12}\right) = 0.05$$

$$f = \frac{1}{0.05} = 20 \text{ Cm}$$

b- $m = -\frac{s'}{s}$

$$s' = \frac{sf}{s-f} = \frac{28 \times 20}{28-20} = \frac{560}{8} = 70 \text{ Cm}$$

$$\therefore m = -\frac{70}{20} = -2.5 \quad \text{(real, inverted, magnified)}$$