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Aim - To find the focal length of a convex mirror using a convex lens

Apparatus

An optical bench with four uprights, a convex mirror, a convex lens, a knitting needle and a half-metre scale

Theory

The focal length of a convex mirror can be determined by introducing a convex lens between the object and the convex mirror. An image can be obtained with the help of a convex lens side by side with the object when the convex mirror reflects the rays along the same path, ie, when the rays fall normally on the mirror. Then, the radius of curvature R, of the mirror is the distance between the screen and the mirror.

The focal length f of the convex mirror is calculated using the formula,

$$f = \frac{\text{Radius of Curvature (R)}}{2}$$

Observations and Calculations

Index correction

Length of the knitting needle $y =$ 22.5 cm

Observed distance with the needle $x =$ 22 cm

between M and I,

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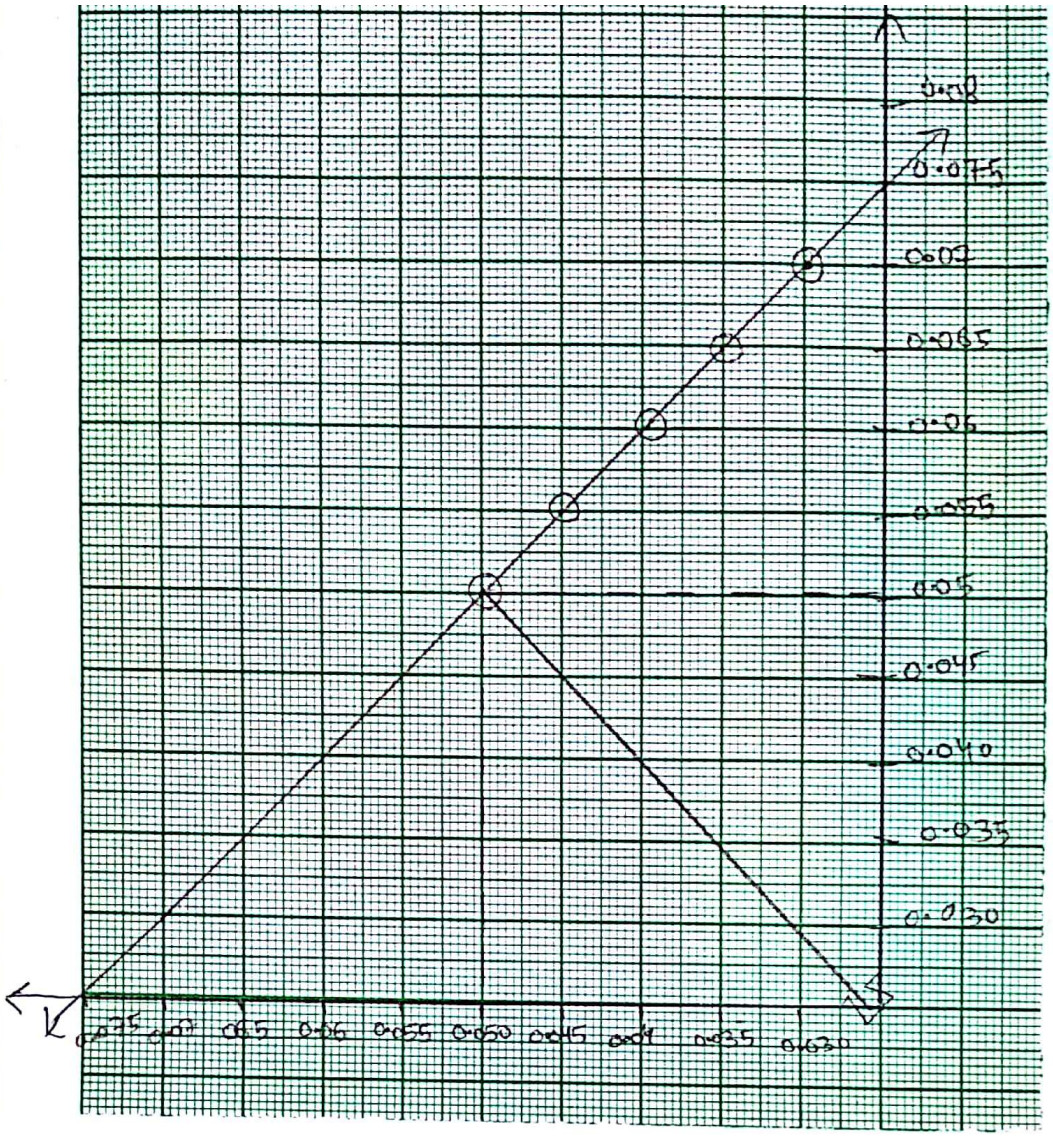

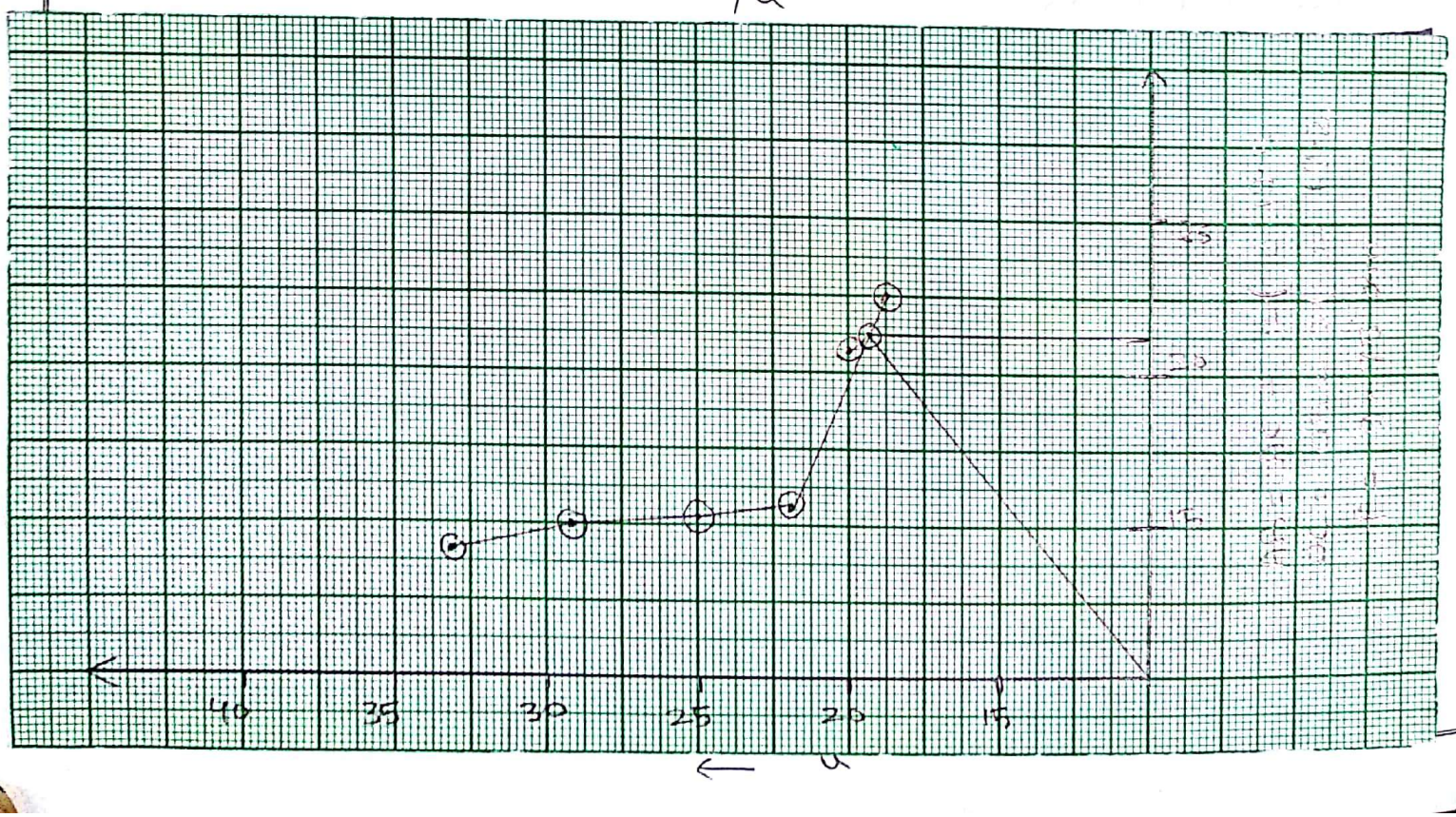

b) for v

4. observed distance between the image needle and the lens when knitting needle is inserted between them, z = 23 cm
5. for index error for v $e_2 = (z - x)$ = 22.5 - 23 = -0.5 cm
6. Index correction for v $(-e_2) = x - z$ = 23 - 22.5 = 0.5 cm

Precautions

1. The tips of the needles should be as high as the optical centre of the lens.
2. Parallax should be removed tip to tip
3. The eye should be placed at such a position that the distance between the image needle and the eye is more than 25 cm

Result

Focal length of the given convex lens as determined from the graph of

i) (u, v) = 10 cm

ii) (u, v) = 10 cm

iii) $\left(\frac{1}{u}, \frac{1}{v}\right)$ = 10 cm

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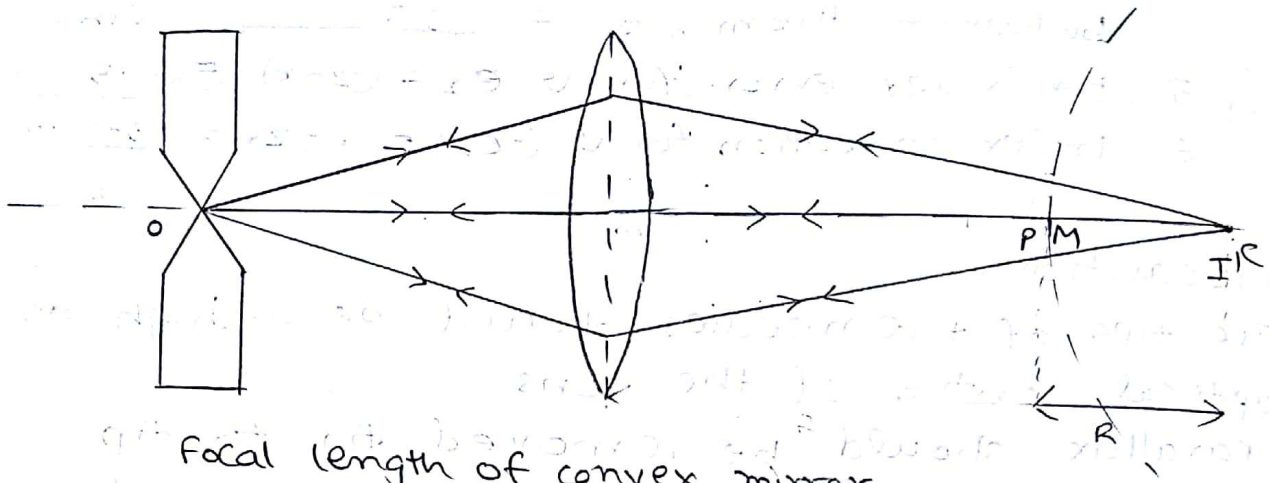

Focal length of convex mirror

S.No	Position of object (O)	Position of lens (l)	Position of mirror	Position of image	M.I.
	39.8	53.9	60.4	90.5	30.8
	40.4	53.9	65.0	97.4	32.4
	40.1	53.9	62.0	96.1	33.1
	40.6	53.9	64.2	98.3	34.8
	41.3	53.9	62.6	99.4	33.4

mean MI = $\frac{164.3}{5}$ = 32.9

Expected distance MI = 32.4

$f = \frac{\text{corrected MI}}{2} = \frac{32.9 - 0.5}{2} = 16.2\ cm$