A53103338

Hw 1 Computer Vision

(I)

$$Q = [2\ -3\ 0] + t[0\ 2\ 1]$$

$$= [2 \quad -3+2t \quad t]$$

Converting Q to Homogeneous coordinates

$$Q^H = [2 \quad -3+2t \quad t \quad 1]$$

Taking Projection of Q^H in image plane

$$\begin{bmatrix} u \\ v \\ w \end{bmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1/f & 0 \end{pmatrix} \begin{pmatrix} 2 \\ -3+2t \\ t \\ 1 \end{pmatrix}$$

$$\begin{bmatrix} u \\ v \\ w \end{bmatrix} = \begin{pmatrix} 2 \\ -3+2t \\ \frac{t}{f} \end{pmatrix}$$

Converting image Homogeneous Coordinates to Euclidean

$$\boxed{(u', v') = \left(\frac{2f}{t}, \left(\frac{-3}{t}+2\right)f\right)}$$

Endpoints

$t = -1$

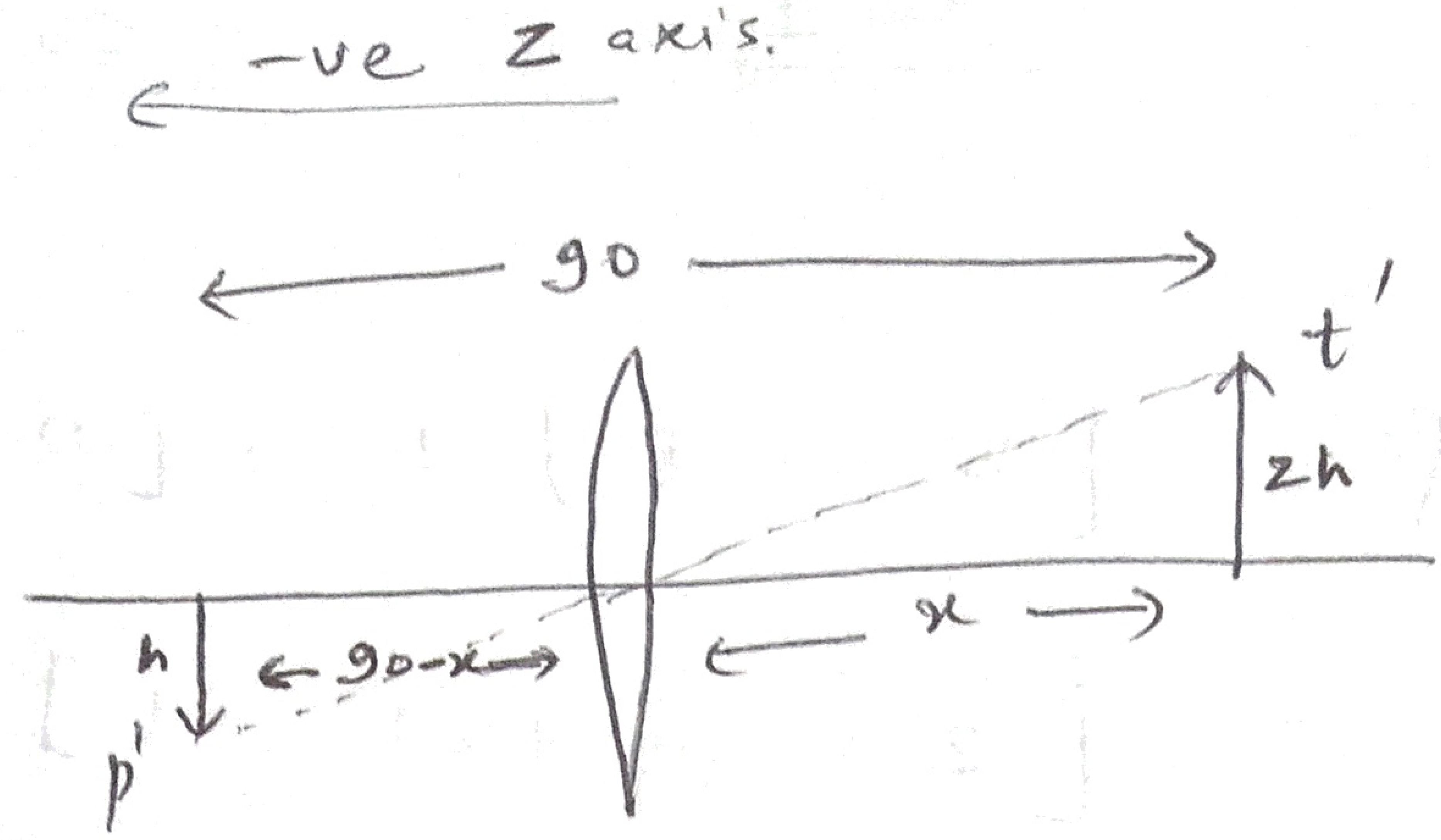
$$(u_{-1}, v_{-1}) = (-2f, 5f)$$

$\lim t \to -\infty$

$$(u_{-\infty}, v_{-\infty}) = (0, 2f).$$

II

1.



~~From thin lens equation~~

By similar triangles,

$$\frac{x}{2h} = \frac{90-x}{h}$$

$$\Rightarrow \quad x = 180 - 2x$$

$$\Rightarrow \quad \boxed{x = 60}$$

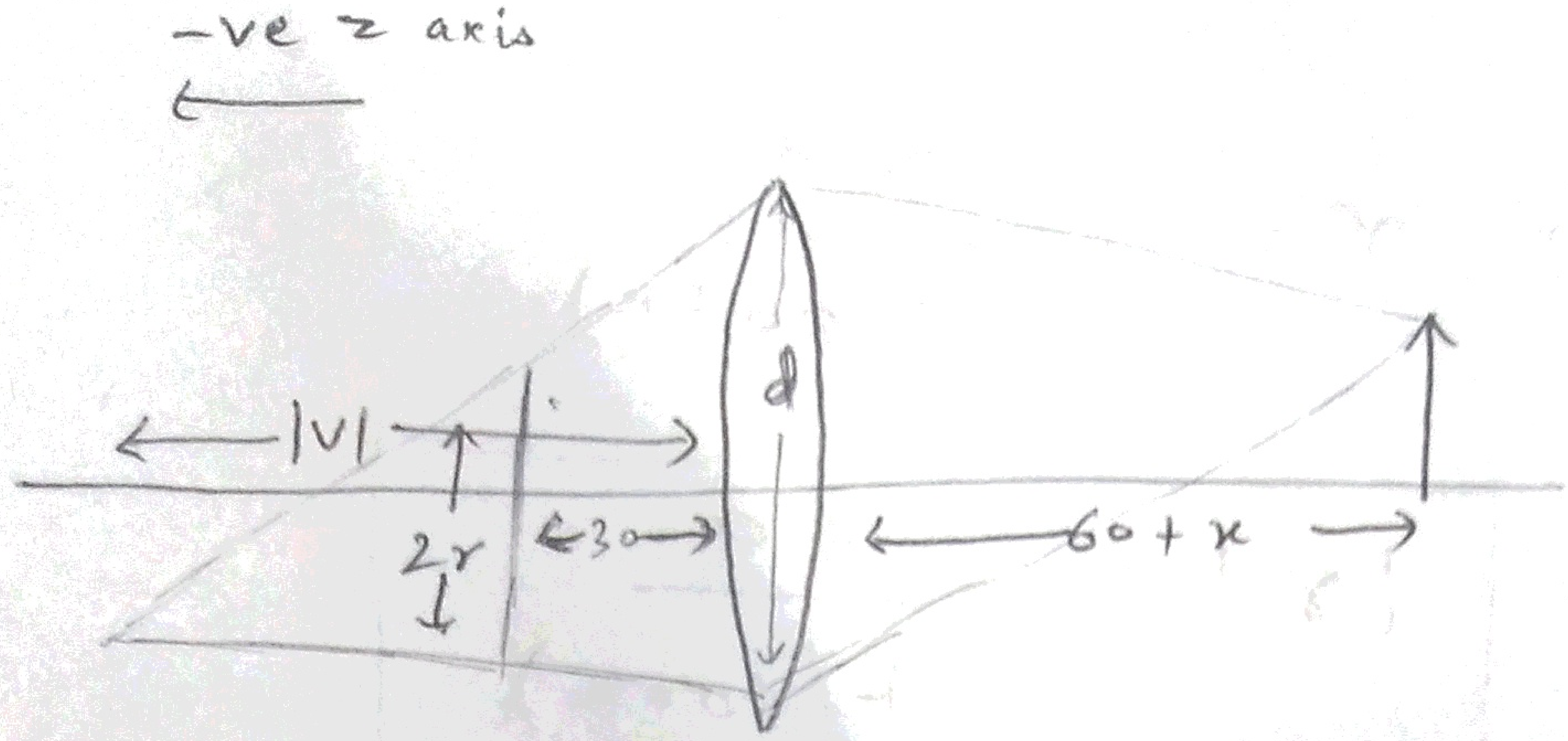
2. By thin lens Equation

$$\frac{1}{f} = \frac{1}{-30} - \frac{1}{60} = \frac{-3}{60} = (-20)^{-1}$$

~~$\Rightarrow$ f =~~ [illegible]

$$\boxed{f = -20}$$

3.



$$\frac{1}{-20} = \frac{1}{v} - \frac{1}{(60+x)} \quad \left[\text{Lens Equation}\right].$$

$$\Rightarrow \quad \frac{1}{v} = \frac{1}{60+x} - \frac{1}{20}$$

$$= \frac{-(40+x)}{20(60+x)}$$

$$\Rightarrow \quad |v| = \frac{20(60+x)}{(40+x)}$$

By similar triangles,

$$\frac{|v|}{d} = \frac{|v|-30}{2r}$$

$$\Rightarrow \quad r = \frac{d}{2}\left(1 - \frac{30}{|v|}\right)$$

$$= \frac{d}{2}\left(1 - \frac{3(40+x)}{2(60+x)}\right)$$

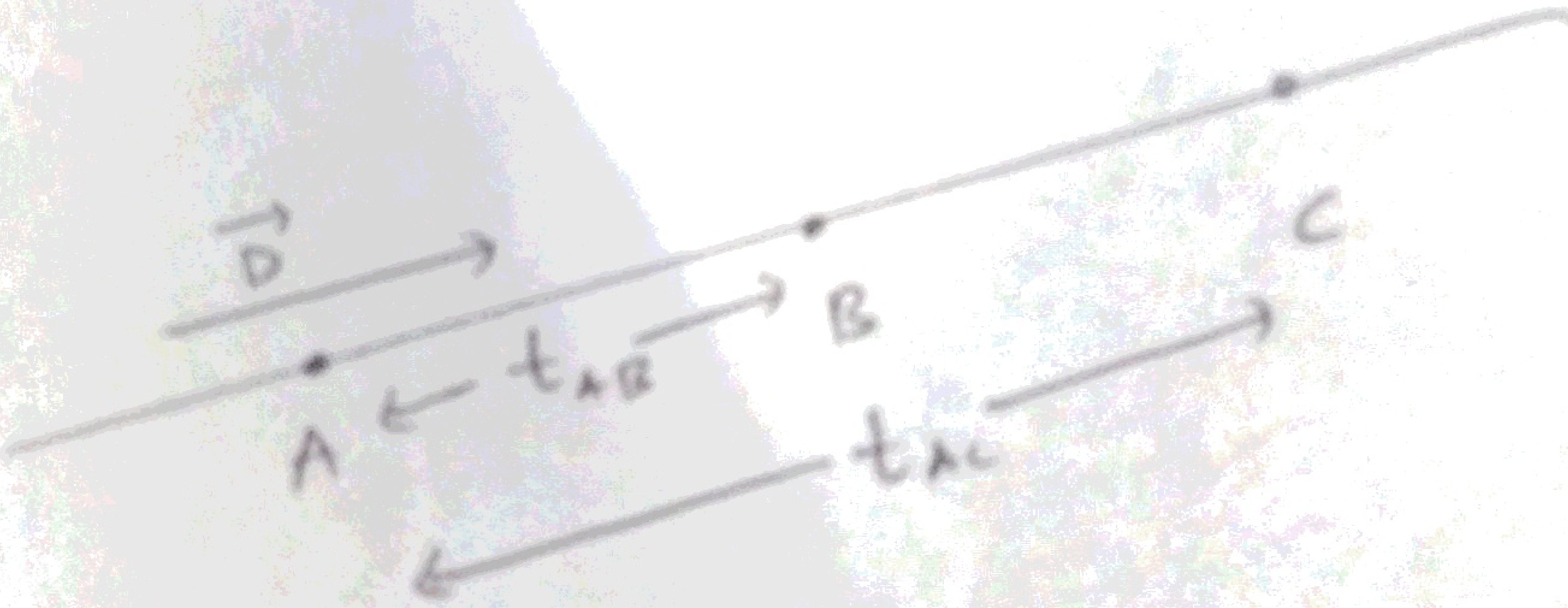
$$= \frac{d}{2}\left(\frac{120+2x-120-3x}{2(60+x)}\right)$$

$$\Rightarrow \gamma = -\frac{x d}{4(60+x)}$$

$$\Rightarrow \boxed{|\gamma| = \frac{x d}{4(60+x)}}$$

γ came negative because image formed before the image plane.

III



t_{AB} & t_{AC} is the Distance between points AB & AC Respecti-vely.

$$B = A + t_{AB} \cdot \vec{D}$$

$$C = A + t_{AC} \cdot \vec{D}$$

$$\text{Ratio} = \left| \frac{t_{AB}}{t_{AC}} \right|$$

Applying Affine Matrix M to these points

$$A' = MA + N$$

$$B' = MB + N$$

$$C' = MC + N$$

$$\text{New Ratio} = \frac{\|B' - A'\|}{\|C' - A'\|} = \frac{\|M\| \, \|B - A\|}{\|M\| \, \|C - A\|}$$

$$= \left| \frac{t_{AB}}{t_{AC}} \right| = \text{old Ratio}$$