Homework-I

Problem: 2:-

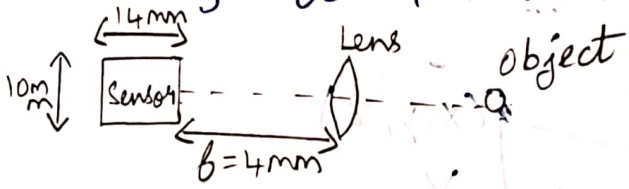
(A) Given

Resolution = 10MP

W_{sensor} = 14mm

H_{sensor} = 10mm

Focal length(f) = 4mm



Field of View in horizontal (FOV_{hor}) = $2\arctan\left(\frac{width}{2 \cdot f}\right)$

$$FOV_{hor} = 2\arctan\left(\frac{14mm}{2 \cdot 4mm}\right)$$

$$= 2\arctan(1.75)$$

$$= 2 \times 60.255^\circ$$

$$\boxed{FOV_{hor} = 120.510^\circ}$$

Field of view in Vertical (FOV_{ver}) = $2\arctan\left(\frac{height}{2 \cdot f}\right)$

$$FOV_{ver} = 2\arctan\left(\frac{10mm}{2.4mm}\right)$$

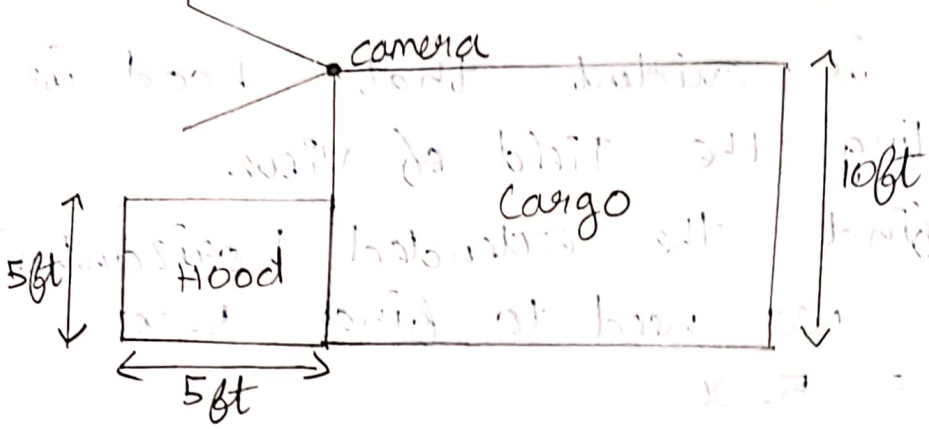
$$= 2\arctan(1.25)$$

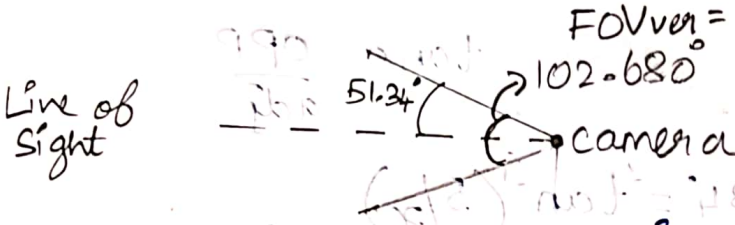
$$= 2 \times 51.340^\circ$$

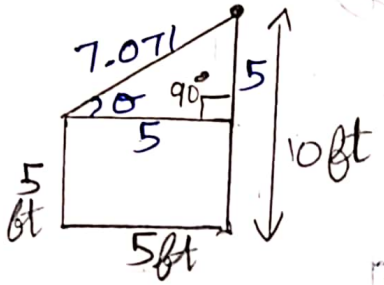
$$= 102.680^\circ$$

$$\boxed{FOV_{ver} = 102.680^\circ}$$

B)







By using Pythogoream theorem

$$\sqrt{5^2+5^2}$$

$$= 7.071$$

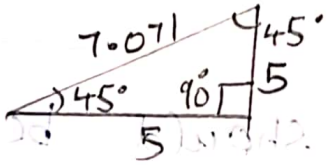
By Trignometry

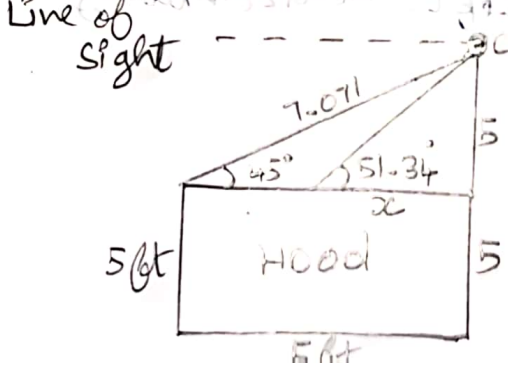
$$\tan\theta = \frac{OPP}{adj} = \frac{5}{5} = 1$$

$$\theta = \tan^{-1}(1)$$

$$\boxed{\theta = 45^\circ}$$

∴ we get



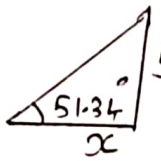


As it is evident that hood is obstructing the Field of View.

To find the extended horizontal length we need to find 5-x

$L_{Ext} = 5 - x$

By Trig on smaller Δle



$\tan\theta = \frac{OPP}{adj}$

$51.34^\circ = \tan^{-1}(5/x)$

$\tan(51.34)^\circ = 5/x$

$1.2499 = 5/x$

$x = 5/1.2499$

$\boxed{x = 4.000 \text{ ft}}$

$\therefore L_{ext} = 5 - x \text{ ft}$

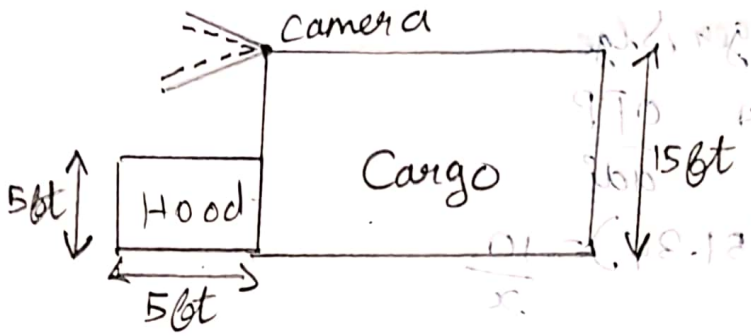
$L_{ext} = 5 - 4.0002$

$L_{ext} = 0.999$

$\boxed{L_{ext} \simeq 1 \text{ ft}}$

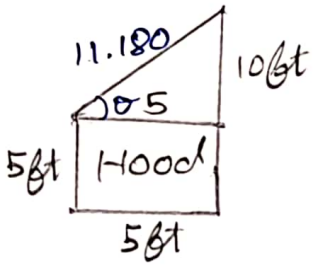
$\therefore$ The camera should be extended by 1 ft towards Left(horizontally)

c)



w.k.T

$FOV_{ver} = 102.68°$



By using Pythogoream theorem

$c = \sqrt{5^2+10^2}$

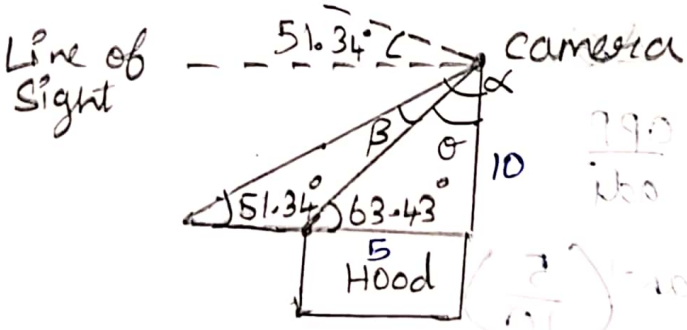
$c = 11.180$

By Trignometry

$$\tan\theta = \frac{opp}{adj} = \frac{10}{5}$$

$$\theta = \tan^{-1}(2)$$

$$\theta = 63.4349°$$



As we know that camera has to be tilted down from 51.34° FOV to 63.43 FOV to cover maximum road we need to find β

$\therefore \beta = \alpha - \theta$

∴ From Larger Δle

$$\tan\theta = \frac{opp}{adj}$$

$$\tan(51.34) = \frac{10}{x}$$

$$1.2499 = \frac{10}{x}$$

$$x = \frac{10}{1.2499}$$

$$\boxed{x = 8.00\,ft}$$

2

$$\tan\alpha = \frac{opp}{adj}$$

$$\alpha = \tan^{-1}\left(\frac{8}{10}\right)$$

$$\boxed{\alpha = 38.659^\circ}$$

From smaller Δle

$$\tan\theta = \frac{opp}{adj}$$

$$\theta = \tan^{-1}\left(\frac{5}{10}\right)$$

$$\theta = 26.565^\circ$$

$$\therefore \beta = \alpha - \theta$$

$$= 38.659^\circ - 26.565^\circ$$

$$= 12.096$$

$$\beta \simeq 12.1^\circ$$

∴ The camera has to be tilted 12.1° downwards