

1.2.25

EE24BTECH11014 - DEEPAK

Question:

Rain is falling vertically with a speed of $30ms^{-1}$. A woman rides a bicycle with a speed of $10ms^{-1}$ in the north to south direction. What is the direction in which she should hold her umbrella?

Solution: :

Variable	Description	value
\mathbf{v}_{rain}	velocity vector of rain in vertical downwards direction	$30ms^{-1}$
\mathbf{v}_{woman}	velocity vector of women in north to south (Horizontal) direction	$10ms^{-1}$
$\mathbf{v}_{relative}$	velocity of rain with respect to woman	
θ	angle with vertical in which she should hold her umbrella	

TABLE 0: Variables Used

$$\mathbf{v}_{rain} = \begin{pmatrix} 0 \\ -30 \end{pmatrix} \text{m/s}$$

$$\mathbf{v}_{woman} = \begin{pmatrix} -10 \\ 0 \end{pmatrix} \text{m/s}$$

velocity of rain with respect to woman :

$$\mathbf{v}_{relative} = \mathbf{v}_{rain} - \mathbf{v}_{woman}$$

$$\mathbf{v}_{relative} = \begin{pmatrix} 0 \\ -30 \end{pmatrix} - \begin{pmatrix} -10 \\ 0 \end{pmatrix}$$

$$\mathbf{v}_{relative} = \begin{pmatrix} 10 \\ -30 \end{pmatrix}$$

So, the relative velocity of the rain with respect to the woman is:

$$\mathbf{v}_{relative} = \begin{pmatrix} 10 \\ -30 \end{pmatrix}, \text{m/s}$$

The direction in which she should hold the umbrella is the direction of the relative velocity vector.

since θ is the angle with the vertical

so,

$$\tan \theta = \frac{10}{-30} = -\frac{1}{3}$$

Thus, the angle θ is:

$$\theta = \tan^{-1}\left(-\frac{1}{3}\right)$$

ector representing the direction of the umbrella (and its oppo

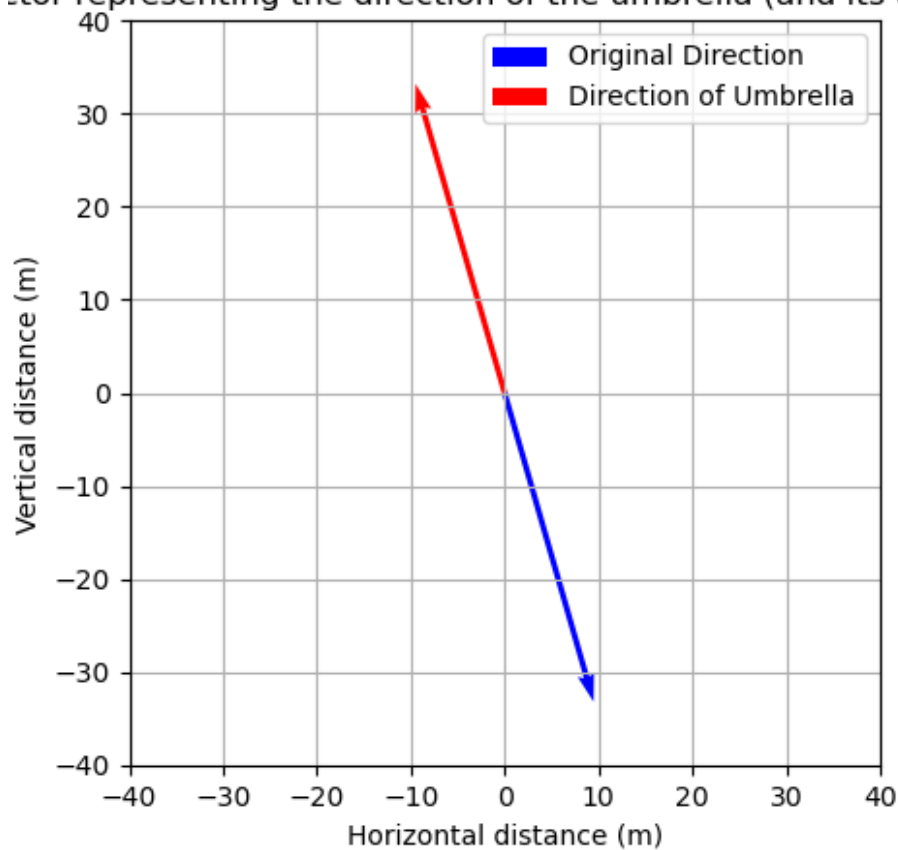


Fig. 0.1