

1-1.2-24

EE24BTECH11063 - Y.Harsha Vardhan Reddy

Question:

Rain is falling vertically with a speed of 35ms^{-1} . A woman rides a bicycle with a speed of 12ms^{-1} in easty to west direction. What is the direction in which she should hold her umbrella ?

Solution:

Variable	Description
V_r	Velocity of rain
V_w	Velocity of woman riding bicycle
$V_{r/w}$	Velocity of rain wrt woman
d_w	Direction of rain wrt to woman
θ	Angle of umbrella relative to vertical

TABLE 0: Variables Used

$$V_r = \begin{pmatrix} 0 \\ -35 \end{pmatrix} \quad (0.1)$$

$$V_w = \begin{pmatrix} -12 \\ 0 \end{pmatrix} \quad (0.2)$$

Let us see the velocity of rain wrt woman,

$$V_{rw} = V_r - V_w \quad (0.3)$$

$$V_{rw} = \begin{pmatrix} 0 \\ -35 \end{pmatrix} - \begin{pmatrix} -12 \\ 0 \end{pmatrix} = \begin{pmatrix} 12 \\ -35 \end{pmatrix} \quad (0.4)$$

The direction of umbrella is negative of velocity of rain wrt woman, Therefore,

$$d_w = -V_{rw} \quad (0.5)$$

$$d_w = \begin{pmatrix} -12 \\ 35 \end{pmatrix} \quad (0.6)$$

And,

$$\theta = \tan^{-1} \left(\frac{\text{horizontal component}}{\text{vertical component}} \right) \quad (0.7)$$

$$\theta = \tan^{-1} \left(\frac{12}{35} \right) \quad (0.8)$$

