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

$$V_r = \begin{pmatrix} 0 \\ -35 \end{pmatrix} \tag{0.1}$$

$$V_w = \begin{pmatrix} -12 \\ 0 \end{pmatrix} \tag{0.2}$$

$$V_{rw} = V_r - V_w \tag{0.3}$$

$$V_{rw} = \begin{pmatrix} 0 \\ -35 \end{pmatrix} - \begin{pmatrix} -12 \\ 0 \end{pmatrix} = \begin{pmatrix} 12 \\ -35 \end{pmatrix} \tag{0.4}$$

$$d_w = -V_{rw} \tag{0.5}$$

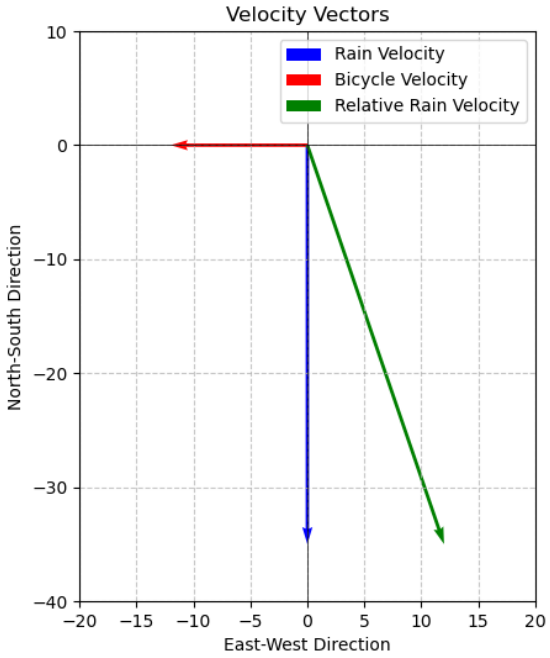
Therefore,

$$d_w = \begin{pmatrix} -12 \\ 35 \end{pmatrix} \tag{0.6}$$

$$\theta = \tan^{-1}\left(\frac{horizontalcomponent}{verticalcomponent}\right) \tag{0.7}$$

Therefore,

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


Velocity Vectors
Rain Velocity
Bicycle Velocity
Relative Rain Velocity
North-South Direction
East-West Direction
10
0
−10
−20
−30
−40
−20
−15
−10
−5
0
5
10
15
20