

# Matgeo-1.2.22

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## 1 Problem

## 2 Solution

- Terms
- Velocity Vectors
- Resultant Velocity Vector
- Direction vector and Slope
- Required Angle
- Plot of Velocity Vectors
- Codes

## Problem Statement

Rain is falling vertically at a speed of  $35\text{ms}^{-1}$ . Winds start blowing after sometime with a speed of  $12\text{ms}^{-1}$  in east to west direction. In which direction should a boy waiting at a bus stop hold his umbrella ?

# Terms

Term	Description
$\mathbf{V}_1$	velocity vector of Rain
$\mathbf{V}_2$	velocity vector Wind
$\mathbf{V}_3$	Resultant velocity vector of Rain and Wind
$\theta$	Angle made by umbrella with horizontal

## velocity Vectors

Velocity vector of rain:

$$\mathbf{v}_1 = \begin{pmatrix} 0 \\ -35 \end{pmatrix} \quad (3.1)$$

Velocity vector of Wind:

$$\mathbf{v}_2 = \begin{pmatrix} -12 \\ 0 \end{pmatrix} \quad (3.2)$$

## Resultant Velocity Vector

The resultant velocity vector:

$$\mathbf{v}_1 + \mathbf{v}_2 = \begin{pmatrix} 0 \\ -35 \end{pmatrix} + \begin{pmatrix} -12 \\ 0 \end{pmatrix} \quad (3.3)$$

$$\mathbf{v}_3 = \begin{pmatrix} -12 \\ -35 \end{pmatrix} \quad (3.4)$$

## Direction vector and Slope

The direction vector of Resultant velocity vector is:

$$\mathbf{D} = \begin{pmatrix} -12 \\ -35 \end{pmatrix} = -12 \begin{pmatrix} 1 \\ \frac{35}{12} \end{pmatrix} \quad (3.5)$$

Slope of direction vector  $D$  is

$$Slope = \frac{35}{12} \quad (3.6)$$

## Required Angle

The required angle( $\theta$ ) made by umbrella axis with the horizontal is;

$$\theta = \tan^{-1} \left( \frac{35}{12} \right) = 71.075^\circ \quad (3.7)$$

$\therefore$  The boy hold the umbrella at an angle  $71.075^\circ$  with horizontal direction



# Plot of Velocity Vectors

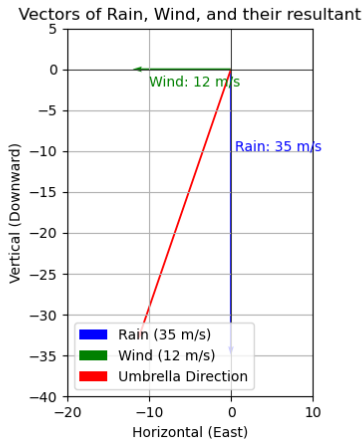


Figure: Plot showing the velocity vectors

# Codes

The C code is:

<https://github.com/Prahladha09/matgeo-1/blob/052f0e157e20ddbdbc2b9bb1bc67a4f8f578951b/assignment-1/codes/angle.c>

The Python code is:

<https://github.com/Prahladha09/matgeo-1/blob/052f0e157e20ddbdbc2b9bb1bc67a4f8f578951b/assignment-1/codes/plot.py>