

a man walks 7.0 miles at 55 degrees north of west. then turns and walks 8.5 miles at east. he turns again and walks 2.0 miles at 64 degrees north of east. what is his displacement

Solution:

Displacement is the distance from the end point and the starting point.

To calculate that, we must find the distances travel in the x and y direction during all three directions of movement.

1. x and y displacement for the first part of the movement (from the right triangle):

$$\cos 55^\circ = \frac{x_1}{7} \Rightarrow x_1 = 7 \cdot \cos 55^\circ = 4.02 \text{ miles}$$

$$\sin 55^\circ = \frac{y_1}{7} \Rightarrow y_1 = 7 \cdot \sin 55^\circ = 5.73 \text{ miles}$$

(Note: 55 degrees North of West means start in west direction and move 55 degrees to the north)

Since the man's x_1 movement goes to the left of the origin, we will say:

$$x_1 \text{ movement} = -4.02 \text{ miles}$$

$$y_1 \text{ movement} = 5.73 \text{ miles}$$

2. x and y displacement for the second part of the movement:

8.5 miles east:

$$x_2 \text{ movement} = 8.5 \text{ miles}$$

$$y_2 \text{ movement} = 0 \text{ miles}$$

3. x and y displacement for the third part of the movement (from the right triangle):

$$\cos 64^\circ = \frac{x_3}{2} \Rightarrow x_3 = 2 \cdot \cos 64^\circ = 0.88 \text{ miles}$$

$$\sin 64^\circ = \frac{y_3}{2} \Rightarrow y_3 = 2 \cdot \sin 64^\circ = 1.80 \text{ miles}$$

(Note: 64 degrees North of east means start at east direction and move 64 degrees North)

$$x_3 \text{ movement} = 0.88 \text{ miles}$$

$$y_3 \text{ movement} = 1.80 \text{ miles}$$

Then we must combine movements in the x direction and combine movements in the y direction:

$$x_{fin} = x_1 + x_2 + x_3 = -4.02 + 8.5 + 0.88 = 5.36$$

$$y_{fin} = y_1 + y_2 + y_3 = 5.73 + 0 + 1.80 = 7.53$$

After that we can use the distance formula to find the distance between the origin (starting point $(0,0)$) and the end point $(x_0 = 0; y_0 = 0)$:

$$d = \sqrt{(x_{fin} - x_0)^2 + (y_{fin} - y_0)^2} = \sqrt{(5.36 - 0)^2 + (7.53 - 0)^2} = 9.25 \text{ miles}$$

Answer: displacement of the man is 9.25 miles.

