The route followed by a hiker consists of three displacement vectors , , and. Vector is along a measured trail and is 2950 m in a direction 42.0° north of east. Vector is not along a measured trail, but the hiker uses a compass and knows that the direction is 37.0° east of south. Similarly, the direction of vector is 39.0 ° north of west. The hiker ends up back where she started, so the resultant displacement is zero, or = 0. Find the magnitudes of (a) vector and (b) vector .

Solution

Let B and C be the required vectors.

Resolving each of the vectors into components N and E, the total components in each direction are:

$$E\text{: } 2950\cos 42 + B\sin 37 - C\cos 39$$

$$N\text{: } 2950\sin 42 - B\cos 37 + C\sin 39$$

As the total vector displacement is 0, each of these components is 0.

$B\sin 37 - C\cos 39 = -2950\cos 42$ (1)

$-B\cos 37 + C\sin 39 = -2950\sin 42$ (2)

Adding (1) $*$ cos 37 to (2) $*$ sin 37:

$$-C(\cos 39\cos 37 - \sin 39\sin 37) = -2950(\cos 42\cos 37 + \sin 42\sin 37)$$

$$C\cos(39 + 37) = 2950\cos(37 - 42)$$

$$C = \frac{2950 * \cos(5)}{\cos(76)} = 12147{,}62m.$$

= 3744.55 m.

Adding (1) $*$ sin 39 to (2) $*$ cos 39:

$$-B(\cos 39\cos 37 - \sin 39\sin 37) = -2950(\sin 39\cos 42 + \cos 39\sin 42)$$

$$-B\cos(39 + 37) = -2950\sin(39 + 42)$$

$$B = \frac{2950 * \sin 81}{\cos(76)} = 12043{,}89m.$$

Answer: (a) $12147,62m$; (b) $12043,89m$.