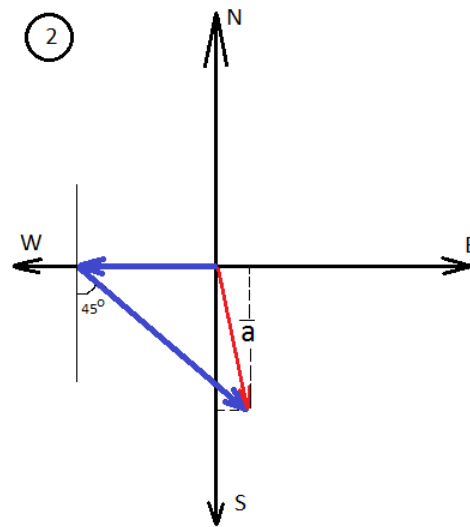
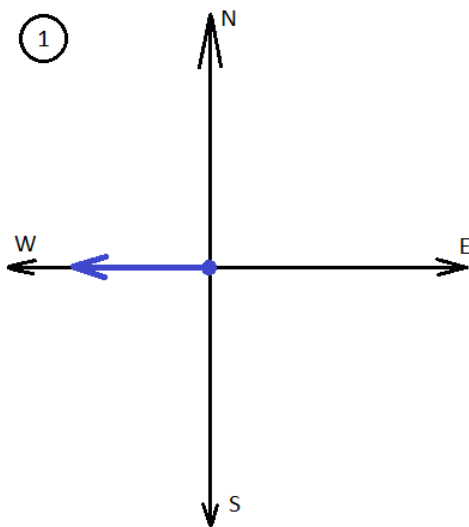


A spelunker is surveying a cave. She follows a passage 150m straight west, then 230m in a direction 45° east of south, and then 280 m at 30° east of north. After a fourth unmeasured displacement, she finds herself back where she started. Determine the magnitude and direction of the fourth displacement.

Solution:

Second displacement:



Resultant vector \vec{a} :

$$\vec{a} = \vec{a}_E + \vec{a}_S$$

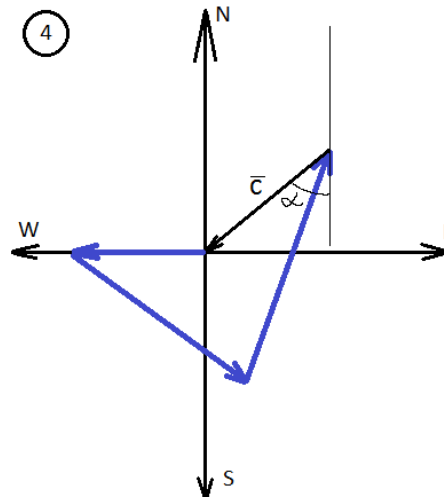
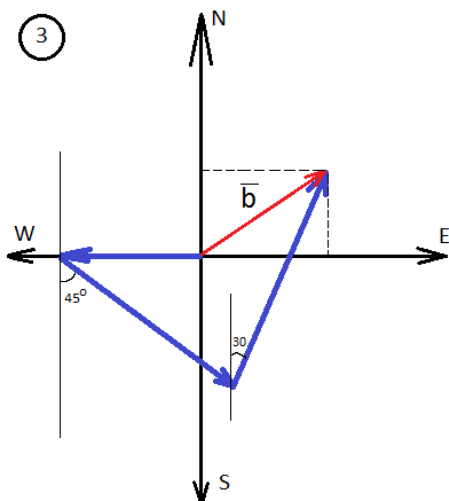
Along the horizontal axis:

$$a_E = -150m + 230m * \cos 45^\circ = 12.6 m$$

Along the vertical axis:

$$a_S = 230m * \sin 45^\circ = 162.6 m$$

Third displacement:



Resultant vector \vec{b} :

$$\vec{b} = \vec{b}_E + \vec{b}_S$$

Along the horizontal axis:

$$b_E = a_E + 280\text{m} * \sin 30^\circ = 152.6 \text{ m}$$

Along the vertical axis:

$$b_S = -a_S + 280\text{m} * \cos 30^\circ = 79.8 \text{ m}$$

Vector to be found - a vector of the opposite vector \vec{b} :

$$\vec{c} = -\vec{b}$$

Length of the vector \vec{b} , Pythagorean Theorem:

$$\begin{aligned} |b| &= \sqrt{b_E^2 + s^2} = \sqrt{152.6^2 + 79.8^2} \\ &= \mathbf{172.7\text{m}} \end{aligned}$$

Angle of the vector \vec{c} :

$$\alpha = \arcsin \frac{b_E}{b} = \arcsin \frac{152.6 \text{ m}}{172.7\text{m}} = \mathbf{62^\circ}$$

So, the fourth displacement has magnitude 172.7m and direction at 62° south of west

Answer: fourth displacement: 172.7m at 62° south of west.

