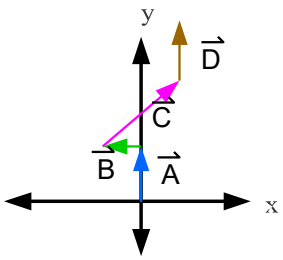
Chapter 2 Problem 54 [†]



Given
$\vec{A} = 40\hat{j}\ km$
$\vec{B} = -20\hat{i}\ km$
$\vec{C} = 60\ km\ \angle 45° = 60\cos(45)\hat{i} + 60\sin(45)\hat{j} = \{42.4\hat{i} + 42.4\hat{j}\}\ km$
$\vec{D} = 50\hat{j}\ km$

Solution
a) The net displacement vector goes from the tail of $\vec{A}$ to the head of $\vec{D}$. This is the sum of all the vectors.

$$\vec{disp} = \vec{A} + \vec{B} + \vec{C} + \vec{D}$$

$$\vec{disp} = 40\hat{j} - 20\hat{i} + (42.4\hat{i} + 42.4\hat{j}) + 50\hat{j}$$

$$\vec{disp} = \{22.4\hat{i} + 132.4\hat{j}\}\ km$$

Assuming these distances are good to the closest kilometer, the displacement vector is

$$\vec{disp} = \{22\hat{i} + 132\hat{j}\}\ km$$

b) How far is the restaurant from the post office?.

This is distance if the magnitude of the displacement vector.

$$disp = \sqrt{(22.4)^2 + (132.4)^2} = 134.3\ km$$

or to the closest kilometer

$$disp = 134\ km$$

c) What is the displacement vector for the return trip?

Assume the delivery man can go directly back to the post office, then the return trip is just the negative of the answer from part a).

$$\vec{return} = -\vec{disp} = -\{22\hat{i} + 132\hat{j}\}\ km = \{-22\hat{i} - 132\hat{j}\}\ km$$

d) What is his compass heading for the return trip?

[†]Problem from University Physics by Ling, Sanny and Moebs (OpenStax)

Using trigonometry, the angle for the return vector is

$$\theta = \tan^{-1}\left(\frac{return_y}{return_x}\right) = \tan^{-1}\left(\frac{-132\ km}{-22\ km}\right)$$

$$\theta = 80.54^\circ$$

Since the direction is in the third quadrant rather than the first, 180° must be added to the angle. Therefore, the direction is 260.5° counter-clockwise from the positive x-axis. Using the directions of the compass, this is 80.5° south of west.