

## Problem 49

Given two displacement vectors  $\vec{A} = (3.00\hat{i} - 4.00\hat{j} + 4.00\hat{k})\text{m}$  and  $\vec{B} = (2.00\hat{i} + 3.00\hat{j} - 7.00\hat{k})\text{m}$ , find the displacements and their magnitudes for (a)  $\vec{C} = \vec{A} + \vec{B}$  and (b)  $\vec{D} = 2\vec{A} - \vec{B}$ .

### Solution

#### Part (a)

The displacement is

$$\begin{aligned}\vec{C} &= \vec{A} + \vec{B} \\ &= (3.00\hat{i} - 4.00\hat{j} + 4.00\hat{k})\text{m} + (2.00\hat{i} + 3.00\hat{j} - 7.00\hat{k})\text{m} \\ &= (3.00 + 2.00)\hat{i}\text{ m} + (-4.00 + 3.00)\hat{j}\text{ m} + (4.00 - 7.00)\hat{k}\text{ m} \\ &= (5.00\hat{i} - 1.00\hat{j} - 3.00\hat{k})\text{m},\end{aligned}$$

and its magnitude is

$$\begin{aligned}|\vec{C}| &= \sqrt{(5.00\text{ m})^2 + (-1.00\text{ m})^2 + (-3.00\text{ m})^2} \\ &= \sqrt{35\text{ m}^2} \\ &\approx 5.92\text{ m}.\end{aligned}$$

#### Part (b)

The displacement is

$$\begin{aligned}\vec{D} &= 2\vec{A} - \vec{B} \\ &= 2(3.00\hat{i} - 4.00\hat{j} + 4.00\hat{k})\text{m} - (2.00\hat{i} + 3.00\hat{j} - 7.00\hat{k})\text{m} \\ &= (6.00\hat{i} - 8.00\hat{j} + 8.00\hat{k})\text{m} - (2.00\hat{i} + 3.00\hat{j} - 7.00\hat{k})\text{m} \\ &= (6.00 - 2.00)\hat{i}\text{ m} + (-8.00 - 3.00)\hat{j}\text{ m} + (8.00 + 7.00)\hat{k}\text{ m} \\ &= (4.00\hat{i} - 11.00\hat{j} + 15.00\hat{k})\text{m},\end{aligned}$$

and its magnitude is

$$\begin{aligned}|\vec{D}| &= \sqrt{(4.00\text{ m})^2 + (-11.00\text{ m})^2 + (15.00\text{ m})^2} \\ &= \sqrt{362\text{ m}^2} \\ &\approx 19.0\text{ m}.\end{aligned}$$