Chapter 2 Problem 52 †

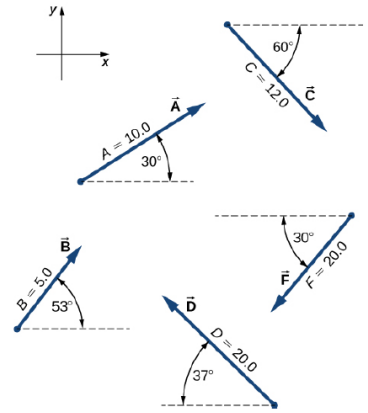

Figure 2.33

Solution

Start by expressing each of the vectors from the diagram in component vector form.

$$\vec{A} = A\cos(\theta)\hat{i} + A\sin(\theta)\hat{j} = 10.0\cos(30°)\hat{i} + 10.0\sin(30°)\hat{j} = 8.66\hat{i} + 5.00\hat{j}$$

$$\vec{B} = B\cos(\theta)\hat{i} + B\sin(\theta)\hat{j} = 5.0\cos(53°)\hat{i} + 5.0\sin(53°)\hat{j} = 3.01\hat{i} + 3.99\hat{j}$$

$$\vec{C} = C\cos(\theta)\hat{i} + C\sin(\theta)\hat{j} = 12.0\cos(-60°)\hat{i} + 12.0\sin(-60°)\hat{j} = 6.00\hat{i} - 10.39\hat{j}$$

We need to be careful with D. It is pointing in the 2nd quadrant. I could express the angle with respect to the positive x-axis and use the formulas as with the previous vectors. If the angle $180° - 37° = 143°$ is used, the signs for the x and y components will be correct. I find an easier way is to use the given angle and explicitely assign the proper signs to the components. In the 2nd quadrant, the x-component should be negative and the y-component should be positive. I will do the same thing for vector F.

$$\vec{D} = D\cos(\theta)\hat{i} + D\sin(\theta)\hat{j} = -20.0\cos(37°)\hat{i} + 20.0\sin(37°)\hat{j} = -15.97\hat{i} + 12.04\hat{j}$$

Vector F is pointing into the 3rd quadrant. Therefore, both the x and y components should be negative.

$$\vec{F} = F\cos(\theta)\hat{i} + F\sin(\theta)\hat{j} = -20.0\cos(30°)\hat{i} - 20.0\sin(30°)\hat{j} = -17.32\hat{i} - 10.00\hat{j}$$

Now we can answer the questions.

a) Find $\vec{A} + \vec{B}$.

$$\vec{A} + \vec{B} = 8.66\hat{i} + 5.00\hat{j} + 3.01\hat{i} + 3.99\hat{j} = 11.67\hat{i} + 8.99\hat{j}$$

b) Find $\vec{A} + \vec{B}$.

$$\vec{C} + \vec{B} = 6.00\hat{i} - 10.39\hat{j} + 3.01\hat{i} + 3.99\hat{j} = 9.01\hat{i} - 6.40\hat{j}$$

c) Find $\vec{D} + \vec{F}$.

$$\vec{D} + \vec{F} = -15.97\hat{i} + 12.04\hat{j} - 17.32\hat{i} - 10.00\hat{j} = -33.29\hat{i} + 2.04\hat{j}$$

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

d) Find $\vec{A} - \vec{B}$.

$$\vec{A} - \vec{B} = (8.66\hat{i} + 5.00\hat{j}) - (3.01\hat{i} + 3.99\hat{j}) = 5.65\hat{i} + 1.01\hat{j}$$

e) Find $\vec{D} - \vec{F}$.

$$\vec{D} - \vec{F} = (-15.97\hat{i} + 12.04\hat{j}) - (-17.32\hat{i} - 10.00\hat{j}) = 1.35\hat{i} + 22.04\hat{j}$$

f) Find $\vec{A} + 2\vec{F}$.

$$\vec{A} + 2\vec{F} = (8.66\hat{i} + 5.00\hat{j}) + 2(-17.32\hat{i} - 10.00\hat{j}) = -25.98\hat{i} + -15.00\hat{j}$$

g) Find $\vec{C} - 2\vec{D} + 3\vec{F}$.

$$\vec{C} - 2\vec{D} + 3\vec{F} = (6.00\hat{i} - 10.39\hat{j}) - 2(-15.97\hat{i} + 12.04\hat{j}) + 3(-17.32\hat{i} - 10.00\hat{j}) = -14.02\hat{i} - 64.47\hat{j}$$

h) Find $\vec{A} - 4\vec{D} + 2\vec{F}$.

$$\vec{A} - 2\vec{D} + 3\vec{F} = (8.66\hat{i} + 5.00\hat{j}) - 4(-15.97\hat{i} + 12.04\hat{j}) + 2(-17.32\hat{i} - 10.00\hat{j}) = 37.90\hat{i} - 63.16\hat{j}$$

It looks like the author might intend the answers be given to the closest 1/10th. You could round the answers I have given to the 1/10th place and see how they compare to your work.