1.37 Write each vector in Fig. E1.24 in terms of the unit vectors $\hat{\imath}$ and $\hat{\jmath}$.

$$\vec{A} = (0)\,\hat{\imath} + (-8.00)\,\hat{\jmath} \tag{1}$$
$$\vec{B} = (7.50)\,\hat{\imath} + (13.0)\,\hat{\jmath} \tag{2}$$
$$\vec{C} = (-10.9)\,\hat{\imath} + (-5.07)\,\hat{\jmath} \tag{3}$$
$$\vec{D} = (-7.99)\,\hat{\imath} + (6.02)\,\hat{\jmath} \tag{4}$$

1.39 (a) Write each vector in Fig. E1.39 in terms of the unit vectors $\hat{\imath}$ and $\hat{\jmath}$. (b) Use unit vectors to express vector $\vec{C}$, where $\vec{C} = 3.00\vec{A} - 4.00\vec{B}$. (c) Find the magnitude and direction of $\vec{C}$.

Find the components of $\vec{A}$ and $\vec{B}$:

$$\vec{A}_x = 3.60\cos(70.0^\circ) \approx 1.23\,\text{m} \tag{5}$$
$$\vec{A}_y = 3.60\sin(70.0^\circ) \approx 3.38\,\text{m} \tag{6}$$
$$\vec{B}_x = 2.4\cos(30.0^\circ + 180^\circ) \approx -2.08\,\text{m} \tag{7}$$
$$\vec{B}_y = 2.4\sin(30.0^\circ + 180^\circ) \approx -1.20\,\text{m} \tag{8}$$

(a)

$$\vec{A} = (1.23)\,\hat{\imath} + (3.38)\,\hat{\jmath} \tag{9}$$
$$\vec{B} = (-2.08)\,\hat{\imath} + (-1.20)\,\hat{\jmath} \tag{10}$$

(b)

$$\vec{C} = 3.00\vec{A} - 4.00\vec{B} \tag{11}$$
$$= 3.00\left((1.23\,\text{m})\,\hat{\imath} + (3.38\,\text{m})\,\hat{\jmath}\right) - 4.00\left((-2.08\,\text{m})\,\hat{\imath} + (-1.20\,\text{m})\,\hat{\jmath}\right) \tag{12}$$
$$= 3.69\hat{\imath} + 10.14\hat{\jmath} + 8.32\hat{\imath} + 4.8\hat{\jmath} \tag{13}$$
$$\approx 12.0\hat{\imath} + 14.94\hat{\jmath} \tag{14}$$

(c)

$$\|\vec{C}\| = \sqrt{(12.0\,\text{m})^2 + (14.94\,\text{m})^2} \approx 19.2\,\text{m} \tag{15}$$
$$\angle\vec{C} = \arctan\left(\frac{14.94\,\text{m}}{12.0\,\text{m}}\right) \times \frac{180}{\pi} \approx 51.2^\circ \tag{16}$$

1.41 Given two vectors $\vec{A} = -2.00\hat{\imath} + 3.00\hat{\jmath} + 4.00\hat{k}$ and $\vec{B} = 3.00\hat{\imath} + 1.00\hat{\jmath} - 3.00\hat{k}$, (a) find the magnitude of each vector; (b) use unit vectors to write an expression for the vector difference $\vec{A} - \vec{B}$; and (c) find the magnitude of the vector difference $\vec{A} - \vec{B}$. Is this the same as the magnitude of $\vec{B} - \vec{A}$? Explain.

(a)

$$\|\vec{A}\| = \sqrt{(-2.00)^2 + (3.00)^2 + (4.00)^2} \approx 5.39 \tag{17}$$

$$\|\vec{B}\| = \sqrt{(3.00)^2 + (1.00)^2 + (-3.00)^2} \approx 4.36 \tag{18}$$

(b)

$$\vec{A} - \vec{B} = \left(-2.00\hat{\imath} + 3.00\hat{\jmath} + 4.00\hat{k}\right) - \left(3.00\hat{\imath} + 1.00\hat{\jmath} - 3.00\hat{k}\right) \tag{19}$$

$$= -5.00\hat{\imath} + 2.00\hat{\jmath} + 7.00\hat{k} \tag{20}$$

(c)

$$\|\vec{A} - \vec{B}\| = \sqrt{(-5.00)^2 + (2.00)^2 + (7.00)^2} = 8.83 \tag{21}$$

Yes, this is the same as the magnitude of $\vec{B} - \vec{A}$ because every component is squared in the calculation of the magnitude, making any differences in signs irrelevant.

Verify:

$$\vec{B} - \vec{A} = \left(3.00\hat{\imath} + 1.00\hat{\jmath} - 3.00\hat{k}\right) - \left(-2.00\hat{\imath} + 3.00\hat{\jmath} + 4.00\hat{k}\right) \tag{22}$$

$$= 5.00\hat{\imath} - 2.00\hat{\jmath} - 7.00\hat{k} \tag{23}$$

$$\|\vec{B} - \vec{A}\| = \sqrt{(5.00)^2 + (-2.00)^2 + (-7.00)^2} = 8.83 \tag{24}$$