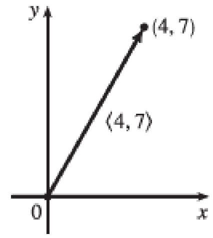
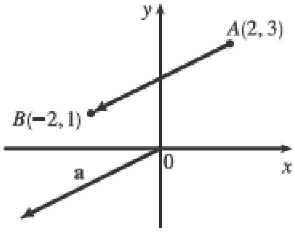
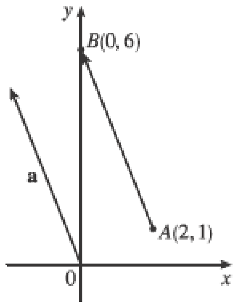
2. If the initial point of the vector $\langle 4, 7\rangle$ is placed at the origin, then $\langle 4, 7\rangle$ is the position vector of the point $(4, 7)$.



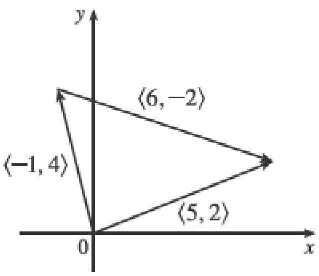
7. $\mathbf{a} = \langle -2-2, 1-3\rangle = \langle -4, -2\rangle$



10. $\mathbf{a} = \langle 0-2, 6-1\rangle = \langle -2, 5\rangle$



13. $\langle -1, 4\rangle + \langle 6, -2\rangle = \langle -1+6, 4+(-2)\rangle = \langle 5, 2\rangle$



18. $\mathbf{a} + \mathbf{b} = (4\,\mathbf{i} + \mathbf{j}) + (\mathbf{i} - 2\mathbf{j}) = 5\,\mathbf{i} - \mathbf{j}$

$2\mathbf{a} + 3\mathbf{b} = 2\,(4\,\mathbf{i} + \mathbf{j}) + 3\,(\mathbf{i} - 2\,\mathbf{j}) = 8\,\mathbf{i} + 2\,\mathbf{j} + 3\,\mathbf{i} - 6\,\mathbf{j} = 11\,\mathbf{i} - 4\,\mathbf{j}$

$|\mathbf{a}| = \sqrt{4^2 + 1^2} = \sqrt{17}$

$|\mathbf{a} - \mathbf{b}| = |(4\,\mathbf{i} + \mathbf{j}) - (\mathbf{i} - 2\,\mathbf{j})| = |3\,\mathbf{i} + 3\,\mathbf{j}| = \sqrt{3^2 + 3^2} = \sqrt{18} = 3\sqrt{2}$

23. The vector $8\,\mathbf{i} - \mathbf{j} + 4\,\mathbf{k}$ has length $|8\,\mathbf{i} - \mathbf{j} + 4\,\mathbf{k}| = \sqrt{8^2 + (-1)^2 + 4^2} = \sqrt{81} = 9$, so by Equation 4 the unit vector with the same direction is $\frac{1}{9}(8\,\mathbf{i} - \mathbf{j} + 4\,\mathbf{k}) = \frac{8}{9}\,\mathbf{i} - \frac{1}{9}\,\mathbf{j} + \frac{4}{9}\,\mathbf{k}$.

28. The given force vectors can be expressed in terms of their horizontal and vertical components as

$20\cos 45^\circ\,\mathbf{i} + 20\sin 45^\circ\,\mathbf{j} = 10\sqrt{2}\,\mathbf{i} + 10\sqrt{2}\,\mathbf{j}$ and $16\cos 30^\circ\,\mathbf{i} - 16\sin 30^\circ\,\mathbf{j} = 8\sqrt{3}\,\mathbf{i} - 8\,\mathbf{j}$. The resultant force $\mathbf{F}$ is the sum of these two vectors: $\mathbf{F} = \left(10\sqrt{2} + 8\sqrt{3}\right)\mathbf{i} + \left(10\sqrt{2} - 8\right)\mathbf{j} \approx 28.00\,\mathbf{i} + 6.14\,\mathbf{j}$. Then we have

$|\mathbf{F}| \approx \sqrt{(28.00)^2 + (6.14)^2} \approx 28.7$ lb and, letting θ be the angle $\mathbf{F}$ makes with the positive x-axis,

$$\tan\theta = \frac{10\sqrt{2} - 8}{10\sqrt{2} + 8\sqrt{3}} \quad\Rightarrow\quad \theta = \tan^{-1}\left(\frac{10\sqrt{2} - 8}{10\sqrt{2} + 8\sqrt{3}}\right) \approx 12.4^\circ.$$

29. The given force vectors can be expressed in terms of their horizontal and vertical components as $-300\,\mathbf{i}$ and

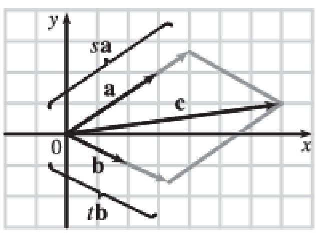
$200\cos 60^\circ\,\mathbf{i} + 200\sin 60^\circ\,\mathbf{j} = 200\left(\frac{1}{2}\right)\,\mathbf{i} + 200\left(\frac{\sqrt{3}}{2}\right)\,\mathbf{j} = 100\,\mathbf{i} + 100\sqrt{3}\,\mathbf{j}$. The resultant force $\mathbf{F}$ is the sum of these two vectors: $\mathbf{F} = (-300 + 100)\,\mathbf{i} + \left(0 + 100\sqrt{3}\right)\mathbf{j} = -200\,\mathbf{i} + 100\sqrt{3}\,\mathbf{j}$. Then we have

$|\mathbf{F}| \approx \sqrt{(-200)^2 + \left(100\sqrt{3}\right)^2} = \sqrt{70{,}000} = 100\sqrt{7} \approx 264.6$ N. Let θ be the angle $\mathbf{F}$ makes with the positive x-axis.

Then $\tan\theta = \dfrac{100\sqrt{3}}{-200} = -\dfrac{\sqrt{3}}{2}$ and the terminal point of $\mathbf{F}$ lies in the second quadrant, so

$$\theta = \tan^{-1}\left(-\frac{\sqrt{3}}{2}\right) + 180^\circ \approx -40.9^\circ + 180^\circ = 139.1^\circ.$$

39. (a), (b)



(c) From the sketch, we estimate that $s \approx 1.3$ and $t \approx 1.6$.

(d) $\mathbf{c} = s\,\mathbf{a} + t\,\mathbf{b} \quad\Leftrightarrow\quad 7 = 3s + 2t$ and $1 = 2s - t$.

Solving these equations gives $s = \frac{9}{7}$ and $t = \frac{11}{7}$.