Section 12.2 - 1, 11, 13, 18, 21, 25, 27, 30, 35, 37

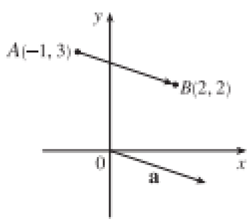
1. (a) The cost of a theater ticket is a scalar, because it has only magnitude.

   (b) The current in a river is a vector, because it has both magnitude (the speed of the current) and direction at any given location.

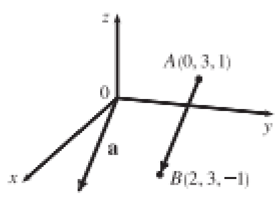
   (c) If we assume that the initial path is linear, the initial flight path from Houston to Dallas is a vector, because it has both magnitude (distance) and direction.

   (d) The population of the world is a scalar, because it has only magnitude.

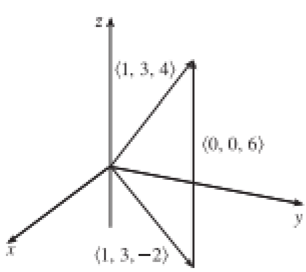
11. $\mathbf{a} = \langle 2-(-1), 2-3 \rangle = \langle 3, -1 \rangle$



13. $\mathbf{a} = \langle 2-0, 3-3, -1-1 \rangle = \langle 2, 0, -2 \rangle$



18. $\langle 1, 3, -2 \rangle + \langle 0, 0, 6 \rangle = \langle 1+0, 3+0, -2+6 \rangle$
$= \langle 1, 3, 4 \rangle$



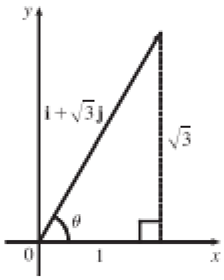
21. $\mathbf{a}+\mathbf{b} = (\mathbf{i}+2\,\mathbf{j}-3\,\mathbf{k}) + (-2\,\mathbf{i}-\mathbf{j}+5\,\mathbf{k}) = -\,\mathbf{i}+\mathbf{j}+2\mathbf{k}$

   $2\mathbf{a}+3\mathbf{b} = 2\,(\mathbf{i}+2\,\mathbf{j}-3\,\mathbf{k}) + 3\,(-2\,\mathbf{i}-\mathbf{j}+5\,\mathbf{k}) = 2\,\mathbf{i}+4\,\mathbf{j}-6\,\mathbf{k}-6\,\mathbf{i}-3\,\mathbf{j}+15\,\mathbf{k} = -\,4\,\mathbf{i}+\mathbf{j}+9\mathbf{k}$

   $|\mathbf{a}| = \sqrt{1^2+2^2+(-3)^2} = \sqrt{14}$

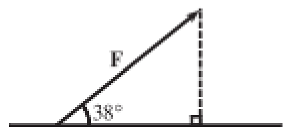
   $|\mathbf{a}-\mathbf{b}| = |(\mathbf{i}+2\,\mathbf{j}-3\,\mathbf{k}) - (-2\,\mathbf{i}-\mathbf{j}+5\,\mathbf{k})| = |3\,\mathbf{i}+3\,\mathbf{j}-8\,\mathbf{k}| = \sqrt{3^2+3^2+(-8)^2} = \sqrt{82}$

25. 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 $\frac{1}{9}(8\,\mathbf{i}-\mathbf{j}+4\,\mathbf{k})=\frac{8}{9}\,\mathbf{i}-\frac{1}{9}\,\mathbf{j}+\frac{4}{9}\,\mathbf{k}$.

27. 

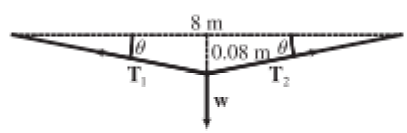
From the figure, we see that $\tan\theta=\dfrac{\sqrt{3}}{1}=\sqrt{3}\quad\Rightarrow\quad\theta=60^\circ$.

30. From the figure, we see that the horizontal component of the force $\mathbf{F}$ is $|\mathbf{F}|\cos 38^\circ=50\cos 38^\circ\approx 39.4$ N, and the vertical component is $|\mathbf{F}|\sin 38^\circ=50\sin 38^\circ\approx 30.8$ N.



35. With respect to the water's surface, the woman's velocity is the vector sum of the velocity of the ship with respect to the water, and the woman's velocity with respect to the ship. If we let north be the positive y-direction, then $\mathbf{v}=\langle 0,22\rangle+\langle -3,0\rangle=\langle -3,22\rangle$. The woman's speed is $|\mathbf{v}|=\sqrt{9+484}\approx 22.2$ mi/h. The vector $\mathbf{v}$ makes an angle θ with the east, where $\theta=\tan^{-1}\left(\frac{22}{-3}\right)\approx 98^\circ$. Therefore, the woman's direction is about N$(98-90)^\circ$W $=$ N8°W.

37. Let $\mathbf{T}_1$ and $\mathbf{T}_2$ represent the tension vectors in each side of the clothesline as shown in the figure. $\mathbf{T}_1$ and $\mathbf{T}_2$ have equal vertical components and opposite horizontal components, so we can write



$\mathbf{T}_1=-a\,\mathbf{i}+b\,\mathbf{j}$ and $\mathbf{T}_2=a\,\mathbf{i}+b\,\mathbf{j}$ $[a,b>0]$. By similar triangles, $\dfrac{b}{a}=\dfrac{0.08}{4}\quad\Rightarrow\quad a=50b$. The force due to gravity acting on the shirt has magnitude $0.8g\approx(0.8)(9.8)=7.84$ N, hence we have $\mathbf{w}=-7.84\,\mathbf{j}$. The resultant $\mathbf{T}_1+\mathbf{T}_2$ of the tensile forces counterbalances $\mathbf{w}$, so $\mathbf{T}_1+\mathbf{T}_2=-\mathbf{w}\quad\Rightarrow\quad(-a\,\mathbf{i}+b\,\mathbf{j})+(a\,\mathbf{i}+b\,\mathbf{j})=7.84\,\mathbf{j}\quad\Rightarrow$ $(-50b\,\mathbf{i}+b\,\mathbf{j})+(50b\,\mathbf{i}+b\,\mathbf{j})=2b\,\mathbf{j}=7.84\,\mathbf{j}\quad\Rightarrow\quad b=\frac{7.84}{2}=3.92$ and $a=50b=196$. Thus the tensions are $\mathbf{T}_1=-a\,\mathbf{i}+b\,\mathbf{j}=-196\,\mathbf{i}+3.92\,\mathbf{j}$ and $\mathbf{T}_2=a\,\mathbf{i}+b\,\mathbf{j}=196\,\mathbf{i}+3.92\,\mathbf{j}$.

Alternatively, we can find the value of θ and proceed as in Example 7.