44. $$\begin{aligned}\frac{1}{2}bc(1 + \cos A) &= \frac{1}{2}bc\left[1 + \frac{b^2 + c^2 - a^2}{2bc}\right]\\ &= \frac{1}{2}bc\left[\frac{2bc + b^2 + c^2 - a^2}{2bc}\right]\\ &= \frac{1}{4}[(b + c)^2 - a^2]\\ &= \frac{1}{4}[(b + c) + a][(b + c) - a]\\ &= \frac{b + c + a}{2} \cdot \frac{b + c - a}{2}\\ &= \frac{a + b + c}{2} \cdot \frac{-a + b + c}{2}\end{aligned}$$

46. $$\begin{aligned}2\csc^2 x - 3 &= \csc^2 x - 1\\ \csc^2 x &= 2\\ \sin^2 x &= \frac{1}{2}\\ \sin x &= \pm\frac{\sqrt{2}}{2}\\ x &= \frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}\end{aligned}$$

48. $\cos x \cot x - \cos x = 0$

$\cos x(\cot x - 1) = 0$

$\cos x = 0$ or $\cot x = 1$

$x = \frac{\pi}{2}, \frac{3\pi}{2}$ $\qquad$ $x = \frac{\pi}{4}, \frac{5\pi}{4}$

50. $\sin\left(x - \frac{\pi}{2}\right) - \sin\left(x + \frac{\pi}{2}\right) = -\cos x - \cos x = -2\cos x$

Section 6.3 Vectors in the Plane

Solutions to Even-Numbered Exercises

2. $\mathbf{u} = \langle 0 - (-3), 4 - (-4)\rangle = \langle 3, 8\rangle$

$\mathbf{v} = \langle 3 - 0, 3 - (-5)\rangle = \langle 3, 8\rangle$

$\mathbf{u} = \mathbf{v}$

4. Initial point: $(0, 0)$

Terminal point: $(4, -2)$

$\mathbf{v} = \langle 4 - 0, -2 - 0\rangle = \langle 4, -2\rangle$

$\|\mathbf{v}\| = \sqrt{4^2 + (-2)^2} = \sqrt{20} = 2\sqrt{5}$

6. Initial point: $(-1, -1)$

Terminal point: $(3, 5)$

$\mathbf{v} = \langle 3 - (-1), 5 - (-1)\rangle = \langle 4, 6\rangle$

$\|\mathbf{v}\| = \sqrt{4^2 + 6^2} = \sqrt{52} = 2\sqrt{13}$

8. Initial point: $(-4, -1)$

Terminal point: $(3, -1)$

$\mathbf{v} = \langle 3 - (-4), -1 - (-1)\rangle = \langle 7, 0\rangle$

$\|\mathbf{v}\| = \sqrt{7^2 + 0^2} = 7$

10. Initial point: $(3.4, 0)$

Terminal point: $(0, 5.8)$

$\mathbf{v} = \langle 0 - 3.4, 5.8 - 0\rangle = \langle -3.4, 5.8\rangle$

$\|\mathbf{v}\| = \sqrt{(-3.4)^2 + (5.8)^2} \approx 6.7$

12. Initial point: $(-3, 11)$

Terminal point: $(9, 40)$

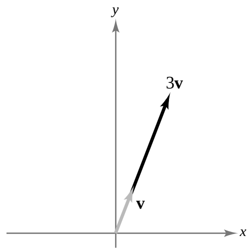
$\mathbf{v} = \langle 9 - (-3), 40 - 11\rangle = \langle 12, 29\rangle$

$\|\mathbf{v}\| = \sqrt{12^2 + 29^2} = \sqrt{985}$

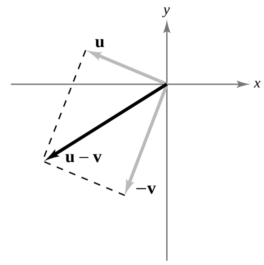
14. $\mathbf{v} = \langle -2.33 - 1.64, 3.86 - 7.21\rangle = \langle -3.97, -3.35\rangle$

$\|\mathbf{v}\| = \sqrt{(-3.97)^2 + (-3.35)^2} = \sqrt{26.9834} \approx 5.19$

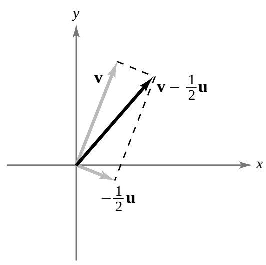
16. $3\mathbf{v}$



18.



20. $\mathbf{v} - \frac{1}{2}\mathbf{u}$



22. (a) $\mathbf{u} + \mathbf{v} = \langle 5, 3\rangle + \langle -4, 0\rangle = \langle 1, 3\rangle$

(b) $\mathbf{u} - \mathbf{v} = \langle 5, 3\rangle - \langle -4, 0\rangle = \langle 9, 3\rangle$

(c) $2\mathbf{u} - 3\mathbf{v} = 2\langle 5, 3\rangle - 3\langle -4, 0\rangle = \langle 22, 6\rangle$

(d) $\mathbf{v} + 4\mathbf{u} = \langle -4, 0\rangle + 4\langle 5, 3\rangle = \langle 16, 12\rangle$

24. (a) $\mathbf{u} + \mathbf{v} = \langle 0, -9\rangle + \langle -6, 10\rangle = \langle -6, 1\rangle$

(b) $\mathbf{u} - \mathbf{v} = \langle 0, -9\rangle - \langle -6, 10\rangle = \langle 6, -19\rangle$

(c) $2\mathbf{u} - 3\mathbf{v} = 2\langle 0, -9\rangle - 3\langle -6, 10\rangle = \langle 18, -48\rangle$

(d) $\mathbf{v} + 4\mathbf{u} = \langle -6, 10\rangle + 4\langle 0, -91\rangle = \langle -6, -26\rangle$

26. $\mathbf{u} = 2\mathbf{i} - \mathbf{j}, \mathbf{v} = -\mathbf{i} + \mathbf{j}$

(a) $\mathbf{u} + \mathbf{v} = \mathbf{i}$

(b) $\mathbf{u} - \mathbf{v} = 3\mathbf{i} - 2\mathbf{j}$

(c) $2\mathbf{u} - 3\mathbf{v} = (4\mathbf{i} - 2\mathbf{j}) - (-3\mathbf{i} + 3\mathbf{j}) = 7\mathbf{i} - 5\mathbf{j}$

(d) $\mathbf{v} + 4\mathbf{u} = 7\mathbf{i} - 3\mathbf{j}$

28. $\mathbf{v} = \langle 0, -3\rangle$

$$\mathbf{u} = \frac{1}{\|\mathbf{v}\|}\mathbf{v} = \frac{1}{\sqrt{0^2 + (-3)^2}}\langle 0, -3\rangle = \frac{1}{3}\langle 0, -3\rangle = \langle 0, -1\rangle$$

30. $\mathbf{v} = \langle 5, -12\rangle$

$$\mathbf{u} = \frac{1}{\|\mathbf{v}\|}\mathbf{v} = \frac{1}{\sqrt{5^2 + (-12)^2}}\langle 5, -12\rangle = \frac{1}{13}\langle 5, -12\rangle = \left\langle \frac{5}{13}, -\frac{12}{13}\right\rangle$$

32. $\mathbf{v} = \langle 8, -20\rangle$

$$\mathbf{u} = \frac{1}{\|\mathbf{v}\|}\mathbf{v} = \frac{1}{\sqrt{64 + 400}}\langle 8, -20\rangle = \frac{1}{\sqrt{29}}\langle 2, -5\rangle = \left\langle \frac{2}{\sqrt{29}}, -\frac{5}{\sqrt{29}}\right\rangle$$

34. $\mathbf{w} = \mathbf{i} - 2\mathbf{j}$

$$\mathbf{u} = \frac{1}{\|\mathbf{w}\|}\mathbf{w}$$

$$= \frac{1}{\sqrt{1^2 + (-2)^2}}(\mathbf{i} - 2\mathbf{j})$$

$$= \frac{1}{\sqrt{5}}(\mathbf{i} - 2\mathbf{j})$$

$$= \frac{\sqrt{5}}{5}\,\mathbf{i} - \frac{2\sqrt{5}}{5}\,\mathbf{j}$$

36. $\mathbf{w} = -3\mathbf{i} \qquad \|\mathbf{w}\| = 3$

$$\mathbf{u} = \frac{1}{3}(-3\mathbf{i}) = -\mathbf{i}$$

38. $\mathbf{v} = 3\left(\frac{1}{\|\mathbf{u}\|}\mathbf{u}\right)$

$$= 3\left(\frac{1}{\sqrt{4^2 + (-4)^2}}\langle 4, -4\rangle\right)$$

$$= 3\left(\frac{1}{4\sqrt{2}}\langle 4, -4\rangle\right)$$

$$= \left\langle \frac{3}{\sqrt{2}}, -\frac{3}{\sqrt{2}} \right\rangle$$

40. $\mathbf{v} = 10\left(\frac{1}{\|\mathbf{u}\|}\mathbf{u}\right)$

$$= 10\left(\frac{1}{\sqrt{4 + 9}}\langle 2, -3\rangle\right)$$

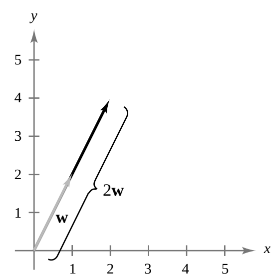
$$= \left\langle \frac{20}{\sqrt{13}}, -\frac{30}{\sqrt{13}} \right\rangle = \frac{20}{\sqrt{13}}\,\mathbf{i} - \frac{30}{\sqrt{13}}\,\mathbf{j}$$

42. $\mathbf{v} = 4\left(\frac{1}{\|\mathbf{u}\|}\,\mathbf{u}\right)$

$$= 4\left(\frac{1}{5}\,\langle 0, 5\rangle\right)$$

$$= \langle 0, 4\rangle = 4\mathbf{j}$$

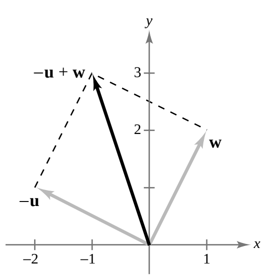
44. $\mathbf{v} = 2\mathbf{w} = 2\langle 1, 2\rangle = \langle 2, 4\rangle$



46. $\mathbf{v} = -\mathbf{u} + \mathbf{w}$

$$= -(2\mathbf{i} - \mathbf{j}) + (\mathbf{i} + 2\mathbf{j})$$

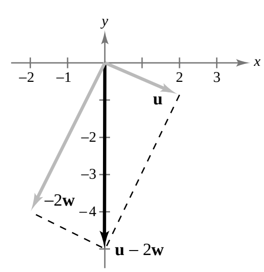
$$= -\mathbf{i} + 3\mathbf{j} = \langle -1, 3\rangle$$



48. $\mathbf{v} = \mathbf{u} - 2\mathbf{w}$

$$= (2\mathbf{i} - \mathbf{j}) - 2(\mathbf{i} + 2\mathbf{j})$$

$$= -5\mathbf{j} = \langle 0, -5\rangle$$



50. $\mathbf{v} = 8(\cos 135^\circ\,\mathbf{i} + \sin 135^\circ\,\mathbf{j})$

$\|\mathbf{v}\| = 8,\ \theta = 135^\circ$

52. $\mathbf{v} = -4\mathbf{i} - 7\mathbf{j}$ Quadrant III

$\|\mathbf{v}\| = \sqrt{(-4)^2 + 7^2} = \sqrt{65}$

$\tan\theta = \dfrac{-7}{-4} = \dfrac{7}{4} \Longrightarrow \theta \approx 240.3°$

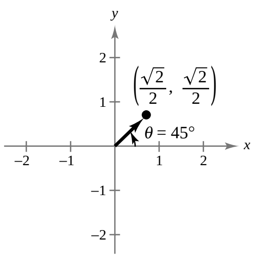
54. $\mathbf{v} = 12\mathbf{i} + 15\mathbf{j}$ Quadrant I

$\|\mathbf{v}\| = \sqrt{12^2 + 15^2} = \sqrt{369} = 3\sqrt{41}$

$\tan\theta = \dfrac{15}{12} \Longrightarrow \theta \approx 51.3°$

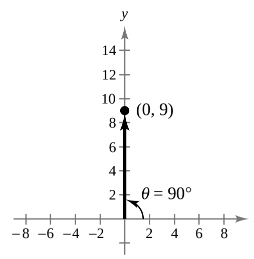
56. $\mathbf{v} = \langle \cos 45°, \sin 45° \rangle$

$= \left\langle \dfrac{\sqrt{2}}{2}, \dfrac{\sqrt{2}}{2} \right\rangle$



58. $\mathbf{v} = \langle 9\cos 90°, 9\sin 90° \rangle$

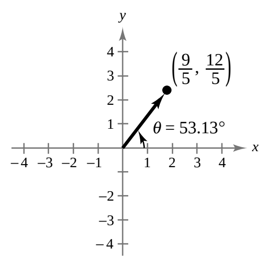
$= \langle 0, 9 \rangle$



60. $\mathbf{v} = 3\left(\dfrac{1}{\sqrt{3^2 + 4^2}}\right)(3\mathbf{i} + 4\mathbf{j})$

$= \dfrac{3}{5}(3\mathbf{i} + 4\mathbf{j})$

$= \dfrac{9}{5}\mathbf{i} + \dfrac{12}{5}\mathbf{j} = \left\langle \dfrac{9}{5}, \dfrac{12}{5} \right\rangle$



62. $\mathbf{u} = \langle 2\cos 30°, 2\sin 30° \rangle = \langle \sqrt{3}, 1 \rangle$

$\mathbf{v} = \langle 2\cos 90°, 2\sin 90° \rangle = \langle 0, 2 \rangle$

$\mathbf{u} + \mathbf{v} = \langle \sqrt{3}, 3 \rangle$

64. $\mathbf{u} = \langle 35\cos 25°, 35\sin 25° \rangle = \langle 31.72, 14.79 \rangle$

$\mathbf{v} = \langle 50\cos 120°, 50\sin 120° \rangle = \langle -25, 25\sqrt{3} \rangle$

$\mathbf{u} + \mathbf{v} \approx \langle 6.72, 58.09 \rangle$

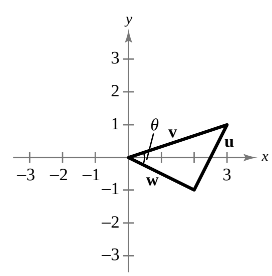
66. $\mathbf{v} = 3\mathbf{i} + \mathbf{j}$

$\mathbf{w} = 2\mathbf{i} - \mathbf{j}$

$\mathbf{u} = \mathbf{v} - \mathbf{w} = \mathbf{i} + 2\mathbf{j}$

$\cos\theta = \dfrac{\|\mathbf{v}\|^2 + \|\mathbf{w}\|^2 - \|\mathbf{v} - \mathbf{w}\|^2}{2\|\mathbf{v}\|\,\|\mathbf{w}\|} = \dfrac{10 + 5 - 5}{2\sqrt{10}\sqrt{5}} = \dfrac{\sqrt{2}}{2}$

$\theta = 45°$



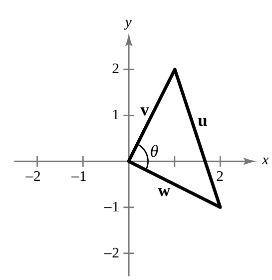
68. $\mathbf{v} = \mathbf{i} + 2\mathbf{j}$

$\mathbf{w} = 2\mathbf{i} - \mathbf{j}$

$\mathbf{u} = \mathbf{v} - \mathbf{w} = -\mathbf{i} + 3\mathbf{j}$

$\cos\theta = \dfrac{\|\mathbf{v}\|^2 + \|\mathbf{w}\|^2 - \|\mathbf{v} - \mathbf{w}\|^2}{2\|\mathbf{v}\|\,\|\mathbf{w}\|} = \dfrac{5 + 5 - 10}{2\sqrt{5}\sqrt{5}} = 0$

$\theta = 90°$



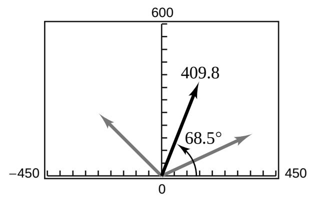
70. Analytically: $\mathbf{v} = 400\langle \cos 25°, \sin 25° \rangle$

$$\mathbf{u} = 300\langle \cos 135°, \sin 135° \rangle$$

$$\mathbf{u} + \mathbf{v} = \langle 150.39, 381.18 \rangle$$

$$\|\mathbf{u} + \mathbf{v}\| = 409.8$$

$$\theta = \arctan\left(\frac{381.18}{150.39}\right) = 68.5°$$



72. Force One: $\mathbf{u} = 3000\mathbf{i}$

Force Two: $\mathbf{v} = 1000 \cos \theta \mathbf{i} + 1000 \sin \theta \mathbf{j}$

Resultant Force: $\mathbf{u} + \mathbf{v} = (3000 + 1000 \cos \theta)\mathbf{i} + 1000 \sin \theta \mathbf{j}$

$$\|\mathbf{u} + \mathbf{v}\| = \sqrt{(3000 + 1000 \cos \theta)^2 + (1000 \sin \theta)^2} = 3750$$

$$9{,}000{,}000 + 6{,}000{,}000 \cos \theta + 1{,}000{,}000 = 14{,}062{,}500$$

$$6{,}000{,}000 \cos \theta = 4{,}062{,}500$$

$$\cos \theta = \frac{4{,}062{,}500}{6{,}000{,}000} \approx 0.6771$$

$$\theta \approx 47.4°$$

74. (a)

$$\mathbf{u} = (70 \cos 30°)\mathbf{i} - (70 \sin 30°)\mathbf{j} \approx 60.62\mathbf{i} - 35\mathbf{j}$$

$$\mathbf{v} = (40 \cos 45°)\mathbf{i} + (40 \sin 45°)\mathbf{j} \approx 28.28\mathbf{i} + 28.28\mathbf{j}$$

$$\mathbf{w} = (60 \cos 135°)\mathbf{i} + (60 \sin 135°)\mathbf{j} \approx -42.43\mathbf{i} + 42.43\mathbf{j}$$

$$\mathbf{u} + \mathbf{v} + \mathbf{w} = 46.47\mathbf{i} + 35.71\mathbf{j}$$

$$\|\mathbf{u} + \mathbf{v} + \mathbf{w}\| \approx 58.61 \text{ pounds}$$

$$\tan \theta \approx \frac{35.71}{46.47} \approx 0.7684$$

$$\theta \approx 37.5°$$

(b)

$$\mathbf{u} = (75 \cos 30°)\mathbf{i} + (75 \sin 30)\mathbf{j} \approx 64.95\mathbf{i} + 37.5\mathbf{j}$$

$$\mathbf{v} = (100 \cos 45°)\mathbf{i} + (100 \sin 45°)\mathbf{j} \approx 70.71\mathbf{i} + 70.71\mathbf{j}$$

$$\mathbf{w} = (125 \cos 120°)\mathbf{i} + (125 \sin 120°)\mathbf{j} \approx -62.5\mathbf{i} + 108.3\mathbf{j}$$

$$\mathbf{u} + \mathbf{v} + \mathbf{w} = 73.16\mathbf{i} + 216.5\mathbf{j}$$

$$\|\mathbf{u} + \mathbf{v} + \mathbf{w}\| = 228.5 \text{ pounds}$$

$$\tan \theta = \frac{216.5}{73.16} \approx 2.9592 \approx 71.3°$$

76. Horizontal component of velocity: $1200 \cos 4° \approx 1197.1$ ft/sec

Vertical component of velocity: $1200 \sin 4° \approx 83.7$ ft/sec

78. Left cable: $\mathbf{u} = \|\mathbf{u}\|(\cos 155.7° \,\mathbf{i} + \sin 155.7° \,\mathbf{j})$

Right cable: $\mathbf{v} = \|\mathbf{v}\|(\cos 44.5° \,\mathbf{i} + \sin 44.5° \,\mathbf{j})$

$\mathbf{u} + \mathbf{v} = 20{,}240\mathbf{j} \Longrightarrow \|\mathbf{u}\| \cos 155.7° + \|\mathbf{v}\| \cos 44.5° = 0$

$\|\mathbf{u}\| \sin 155.7° + \|\mathbf{v}\| \sin 44.5° = 20{,}240$

$\Longrightarrow \quad -0.9114 \|\mathbf{u}\| + 0.7133 \|\mathbf{v}\| = 0$

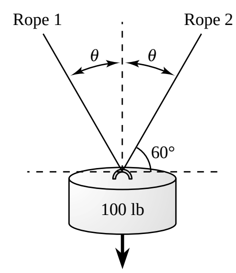
$0.4115 \|\mathbf{u}\| + 0.7009 \|\mathbf{v}\| = 20{,}240$

Solving this system for $\|\mathbf{u}\|$ and $\|\mathbf{v}\|$ yields

$\|\mathbf{u}\| = 15{,}485$ pounds   Tension of left cable

$\|\mathbf{v}\| = 19{,}786$ pounds   Tension of right cable

80. (a) Rope 1: $\mathbf{u} = \|\mathbf{u}\|(\cos 60°\mathbf{i} + \sin 60°\mathbf{j})$



Rope 2: $\mathbf{v} = \|\mathbf{v}\|(\cos 120°\mathbf{i} + \sin 120°\mathbf{j})$

$\mathbf{u} + \mathbf{v} = 100\mathbf{j} \Longrightarrow \|\mathbf{u}\| \cos 60° + \|\mathbf{u}\| \cos 120° = 0$

$\|\mathbf{u}\| \sin 60° + \|\mathbf{v}\| \sin 120° = 100\mathbf{j}$

$$\frac{1}{2}\|\mathbf{u}\| - \frac{1}{2}\|\mathbf{v}\| = 0 \Longrightarrow \|\mathbf{u}\| = \|\mathbf{v}\|$$

$$\frac{\sqrt{3}}{2}\|\mathbf{u}\| + \frac{\sqrt{3}}{2}\|\mathbf{v}\| = \sqrt{3}\|\mathbf{u}\| = 100 \Longrightarrow \|\mathbf{u}\| = \|\mathbf{v}\| = 57.7 \text{ pounds}$$

(b) $\mathbf{u} = \|\mathbf{u}\|(\cos(90 - \theta)\,\mathbf{i} + \sin(90 - \theta)\,\mathbf{j})$

$\mathbf{v} = \|\mathbf{v}\|(\cos(90 + \theta)\,\mathbf{i} + \sin(90 + \theta)\,\mathbf{j})$

$\mathbf{u} + \mathbf{v} = 100\,\mathbf{j} \Longrightarrow \|\mathbf{u}\| \cos(90 - \theta) + \|\mathbf{v}\| \cos(90 + \theta) = 0$

$\Longrightarrow \|\mathbf{u}\| = \|\mathbf{v}\|$, and

$100 = \|\mathbf{u}\| \sin(90 - \theta) + \|\mathbf{u}\| \sin(90 + \theta)$

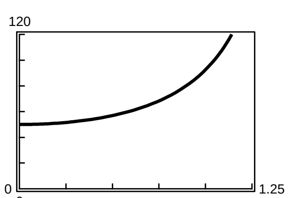
$= 2\|\mathbf{u}\| \cos\theta$

Hence, $\|\mathbf{u}\| = T = \dfrac{50}{\cos\theta} = 50 \sec\theta >$ Domain: $0° \le \theta \le 90°$

(c)

θ	10°	20°	30°	40°	50°	60°
T	50.8	53.2	57.7	65.3	77.8	100

(d)



(e) The vertical component of the vectors decreases as θ increases.

82. Plane: $\mathbf{u} = (580 \cos 150°)\mathbf{i} + (580 \sin 150°)\mathbf{j} \approx -502.3\mathbf{i} + 290\mathbf{j}$

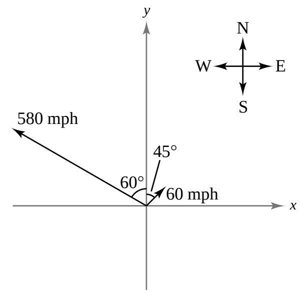
Wind: $\mathbf{v} = (60 \cos 45°)\mathbf{i} + (60 \sin 45°)\mathbf{j} \approx 42.4\mathbf{i} + 42.4\mathbf{j}$

$$\mathbf{u} + \mathbf{v} \approx -459.9\mathbf{i} + 332.4\mathbf{j}$$

$$\|\mathbf{u} + \mathbf{v}\| \approx \sqrt{(-459.9)^2 + (332.4)^2} \approx 567.4$$

$$\tan\theta \approx -\frac{332.4}{459.9} \approx -0.7229 \implies \theta \approx 144.1°$$

The ground speed is 567.4 miles per hour and the heading is N 54.1° W.



84. (a) Horizontal force: $\mathbf{u} = \|\mathbf{u}\|\mathbf{i}$

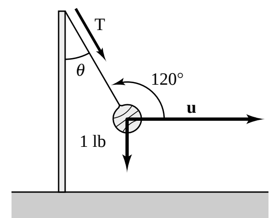
Weight: $\mathbf{w} = -\mathbf{j}$

Rope Tension: $\mathbf{T} = \|\mathbf{T}\|(\cos 120°\mathbf{i} + \sin 120°\mathbf{j})$

$$\mathbf{u} + \mathbf{w} + \mathbf{T} = \mathbf{0} \implies \|\mathbf{u}\| + \|\mathbf{T}\| \cos 120° = 0$$

$$-1 + \|\mathbf{T}\| \sin 120° = 0$$

Hence, $\|\mathbf{T}\|\dfrac{\sqrt{3}}{2} = 1 \implies \|\mathbf{T}\| = \dfrac{2}{\sqrt{3}} \approx 1.15$ lbs and $\|\mathbf{u}\| = \|\mathbf{T}\|\left(\dfrac{1}{2}\right) \approx 0.58$ lbs.



(b) $\mathbf{T} = \|\mathbf{T}\|(\cos(90 + \theta)\mathbf{i} + \sin(90 + \theta)\mathbf{j})$

$$\mathbf{u} + \mathbf{w} + \mathbf{T} = \mathbf{0} \implies \|\mathbf{u}\| + \|\mathbf{T}\| \cos(90 + \theta) = 0$$

$$\|\mathbf{u}\| - \|\mathbf{T}\| \sin\theta = 0$$

$$-1 + \|\mathbf{T}\| \sin(90 + \theta) = 0$$

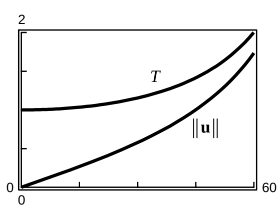
$$-1 + \|\mathbf{T}\| \cos\theta = 0 \implies \|\mathbf{T}\| = \sec\theta,\ 0 \le \theta < \frac{\pi}{2}$$

Hence, $\|\mathbf{u}\| = \|\mathbf{T}\| \sin\theta = \sec\theta \sin\theta = \tan\theta,\ 0 \le \theta < \pi/2$.

(c)

θ	0°	10°	20°	30°	40°	50°	60°
T	1	1.02	1.06	1.15	1.31	1.56	2
$\|\mathbf{u}\|$	0	0.18	0.36	0.58	0.84	1.19	1.73

(d)



(e) Both **T** and $\|\mathbf{u}\|$ increases as θ increases, and approach each other in magnitude.

86. True, $\mathbf{u} = \dfrac{\mathbf{v}}{\|\mathbf{v}\|}$

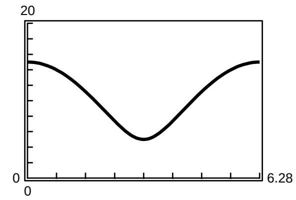
88. True

90. $\mathbf{F}_1 = \langle 10, 0 \rangle, \mathbf{F}_2 = 5\langle \cos\theta, \sin\theta \rangle$

(a) $\mathbf{F}_1 + \mathbf{F}_2 = \langle 10 + 5\cos\theta, 5\sin\theta \rangle$

$$\begin{aligned}\|\mathbf{F}_1 + \mathbf{F}_2\| &= \sqrt{(10 + 5\cos\theta)^2 + (5\sin\theta)^2}\\ &= \sqrt{100 + 100\cos\theta + 25\cos^2\theta + 25\sin^2\theta}\\ &= 5\sqrt{4 + 4\cos\theta + \cos^2\theta + \sin^2\theta}\\ &= 5\sqrt{4 + 4\cos\theta + 1}\\ &= 5\sqrt{5 + 4\cos\theta}\end{aligned}$$

(b)



(c) Range: $[5, 15]$
Maximum is 15 when $\theta = 0$.
Minimum is 5 when $\theta = \pi$.

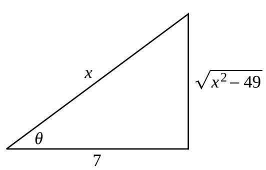
(d) The magnitude of the resultant is never 0 because the magnitudes of $\mathbf{F}_1$ and $\mathbf{F}_2$ are not the same.

92. The following program is written for a *TI-82* or *TI-83* graphing calculator. The program sketches two vectors $\mathbf{u} = a\mathbf{i} + b\mathbf{j}$ and $\mathbf{v} = c\mathbf{i} + d\mathbf{j}$ in standard position, and then sketches the vector difference $\mathbf{u} - \mathbf{v}$ using the parallelogram law.

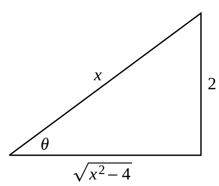
```
PROGRAM:  SUBVECT
:Input "ENTER A", A
:Input "ENTER B", B
:Input "ENTER C", C
:Input "ENTER D", D
:Line (0, 0, A, B)
:Line (0, 0, C, D)
:Pause
:A-C→E
:B-D→F
:Line (A, B, C, D)
:Line (A, B, E, F)
:Line (0, 0, E, F)
:Pause
:ClrDraw
:Stop
```

94.
$$\begin{aligned}\mathbf{u} &= \langle 80 - 10, 80 - 60 \rangle = \langle 70, 20 \rangle\\ \mathbf{v} &= \langle -20 - (-100), 70 - 0 \rangle = \langle 80, 70 \rangle\\ \mathbf{u} - \mathbf{v} &= \langle 70 - 80, 20 - 70 \rangle = \langle -10, -50 \rangle\\ \mathbf{v} - \mathbf{u} &= \langle 80 - 70, 70 - 20 \rangle = \langle 10, 50 \rangle\end{aligned}$$

96. $\sqrt{x^2 - 49} = 7\tan\theta$



98. $\sqrt{x^2 - 4} = 2\cot\theta$



100. $A = 180° - B - C = 52°$

$$b = \frac{c}{\sin C}\sin B \approx 13.2$$

$$a = \frac{c}{\sin C}\sin A \approx 27.9$$

102. $c^2 = a^2 + b^2 - 2ab\cos C \approx 257.27 \Longrightarrow c \approx 16.0$

$$\sin B = \frac{\sin C}{c} \cdot b \approx 0.4040 \Longrightarrow B \approx 23.8°$$

$$A = 180° - B - C = 60.2°$$