4. If $R = (-2, -1)$ and $S = (2, 4)$, then, using the HMT rule,
$\overrightarrow{RS} = \langle 2 - (-2), 4 - (-1) \rangle = \langle 4, 5 \rangle$.
If $P = (-3, -1)$ and $Q = (1, 4)$, then, using the HMT rule,
$\overrightarrow{PQ} = \langle 1 - (-3), 4 - (-1) \rangle = \langle 4, 5 \rangle$.
Both vectors represent $\langle 4, 5 \rangle$ by the HMT rule.

5. $\overrightarrow{PQ} = \langle 3 - (-2), 4 - 2 \rangle = \langle 5, 2 \rangle$,
$|\overrightarrow{PQ}| = \sqrt{5^2 + 2^2} = \sqrt{29}$

6. $\overrightarrow{RS} = \langle 2 - (-2), -8 - 5 \rangle = \langle 4, -13 \rangle$,
$|\overrightarrow{RS}| = \sqrt{4^2 + (-13)^2} = \sqrt{185}$

45. (a) $\mathbf{v} = 10\langle \cos 70°, \sin 70° \rangle \approx \langle 3.42, 9.40 \rangle$

(b) The horizontal component is the (constant) horizontal speed of the basketball as it travels toward the basket. The vertical component is the vertical velocity of the basketball, affected by both the initial speed and the downward pull of gravity.

46. (a) [illegible]

7. $\overrightarrow{QR} = \langle -2 - 3, 5 - 4 \rangle = \langle -5, 1 \rangle$,
$|\overrightarrow{QR}| = \sqrt{(-5)^2 + 1^2} = \sqrt{26}$

8. $\overrightarrow{PS} = \langle 2 - (-2), -8 - 2 \rangle = \langle 4, -10 \rangle$,
$|\overrightarrow{PS}| = \sqrt{4^2 + (-10)^2} = \sqrt{116} = 2\sqrt{29}$

9. $2\overrightarrow{QS} = 2\langle 2 - 3, -8 - 4 \rangle = \langle -2, -24 \rangle$,
$|2\overrightarrow{QS}| = \sqrt{(-2)^2 + (-24)^2} = \sqrt{580} = 2\sqrt{145}$

10. $(\sqrt{2})\,\overrightarrow{PR} = \sqrt{2}\langle -2 - (-2), 5 - 2 \rangle = \langle 0, 3\sqrt{2} \rangle$,
$|\sqrt{2}\,\overrightarrow{QR}| = \sqrt{0^2 + (3\sqrt{2})^2} = 3\sqrt{2}$

11. $3\overrightarrow{QR} + \overrightarrow{PS} = 3\langle -5, 1 \rangle + \langle 4, -10 \rangle = \langle -11, -7 \rangle$,
$|3\overrightarrow{QR} + \overrightarrow{PS}| = \sqrt{(-11)^2 + (-7)^2} = \sqrt{170}$

12. $\overrightarrow{PS} - 3\overrightarrow{PQ} = \langle 4, -10 \rangle - 3\langle 5, 2 \rangle = \langle -11, -16 \rangle$,
$|\overrightarrow{PS} - 3\overrightarrow{PQ}| = \sqrt{(-11)^2 + (-16)^2} = \sqrt{377}$

13. $\langle -1, 3 \rangle + \langle 2, 4 \rangle = \langle 1, 7 \rangle$

14. $\langle -1, 3 \rangle - \langle 2, 4 \rangle = \langle -3, -1 \rangle$

15. $\langle -1, 3 \rangle - \langle 2, -5 \rangle = \langle -3, 8 \rangle$

16. $3\langle 2, 4 \rangle = \langle 6, 12 \rangle$

17. $2\langle -1, 3 \rangle + 3\langle 2, -5 \rangle = \langle 4, -9 \rangle$

18. $2\langle -1, 3 \rangle - 4\langle 2, 4 \rangle = \langle -10, -10 \rangle$

19. $-2\langle -1, 3 \rangle - 3\langle 2, 4 \rangle = \langle -4, -18 \rangle$

20. $-\langle -1, 3 \rangle - \langle 2, 4 \rangle = \langle -1, -7 \rangle$

21. $\dfrac{\mathbf{u}}{|\mathbf{u}|} = \left\langle \dfrac{-2}{\sqrt{(-2)^2 + 4^2}}, \dfrac{4}{\sqrt{(-2)^2 + 4^2}} \right\rangle$
$= -\dfrac{1}{\sqrt{5}}\mathbf{i} + \dfrac{2}{\sqrt{5}}\mathbf{j}$

22. $\dfrac{\mathbf{v}}{|\mathbf{v}|} = \left\langle \dfrac{1}{\sqrt{1^2 + (-1)^2}}, \dfrac{-1}{\sqrt{1^2 + (-1)^2}} \right\rangle$
$= \dfrac{1}{\sqrt{2}}\mathbf{i} - \dfrac{1}{\sqrt{2}}\mathbf{j}$

23. $\dfrac{\mathbf{w}}{|\mathbf{w}|} = \left\langle \dfrac{-1}{\sqrt{(-1)^2 + (-2)^2}}, \dfrac{-2}{\sqrt{(-1)^2 + (-2)^2}} \right\rangle$
$= -\dfrac{1}{\sqrt{5}}\mathbf{i} - \dfrac{2}{\sqrt{5}}\mathbf{j}$

24. $\dfrac{\mathbf{w}}{|\mathbf{w}|} = \left\langle \dfrac{5}{\sqrt{5^2 + 5^2}}, \dfrac{5}{\sqrt{5^2 + 5^2}} \right\rangle$
$= \dfrac{1}{\sqrt{2}}\mathbf{i} + \dfrac{1}{\sqrt{2}}\mathbf{j}$

For #25–28, the unit vector in the direction of $\mathbf{v} = \langle a, b \rangle$ is
$\dfrac{1}{|\mathbf{v}|} = \left\langle \dfrac{a}{\sqrt{a^2 + b^2}}, \dfrac{b}{\sqrt{a^2 + b^2}} \right\rangle$
$= \dfrac{a}{\sqrt{a^2 + b^2}}\mathbf{i} + \dfrac{b}{\sqrt{a^2 + b^2}}\mathbf{j}$.

25. (a) $\left\langle \dfrac{2}{\sqrt{5}}, \dfrac{1}{\sqrt{5}} \right\rangle$

(b) $\dfrac{2}{\sqrt{5}}\mathbf{i} + \dfrac{1}{\sqrt{5}}\mathbf{j}$

26. (a) $\left\langle -\dfrac{3}{\sqrt{13}}, \dfrac{2}{\sqrt{13}} \right\rangle$

(b) $-\dfrac{3}{\sqrt{13}}\mathbf{i} + \dfrac{2}{\sqrt{13}}\mathbf{j}$

27. (a) $\left\langle -\dfrac{4}{\sqrt{41}}, -\dfrac{5}{\sqrt{41}} \right\rangle$

(b) $-\dfrac{4}{\sqrt{41}}\mathbf{i} + \left(-\dfrac{5}{\sqrt{41}}\right)\mathbf{j} = -\dfrac{4}{\sqrt{41}}\mathbf{i} - \dfrac{5}{\sqrt{41}}\mathbf{j}$

28. (a) $\left\langle \dfrac{3}{5}, -\dfrac{4}{5} \right\rangle$

(b) $\dfrac{3}{5}\mathbf{i} + \left(-\dfrac{4}{5}\right)\mathbf{j} = \dfrac{3}{5}\mathbf{i} - \dfrac{4}{5}\mathbf{j}$

29. $\mathbf{v} = \langle 18\cos 25°, 18\sin 25° \rangle \approx \langle 16.31, 7.61 \rangle$

30. $\mathbf{v} = \langle 14\cos 55°, 14\sin 55° \rangle \approx \langle 8.03, 11.47 \rangle$

31. $\mathbf{v} = \langle 47\cos 108°, 47\sin 108° \rangle \approx \langle -14.52, 44.70 \rangle$

32. $\mathbf{v} = \langle 33\cos 136°, 33\sin 136° \rangle \approx \langle -23.74, 22.92 \rangle$

33. $|\mathbf{u}| = \sqrt{3^2 + 4^2} = 5, \alpha = \cos^{-1}\left(\dfrac{3}{5}\right) \approx 53.13°$

34. $|\mathbf{u}| = \sqrt{(-1)^2 + 2^2} = \sqrt{5}, \alpha = \cos^{-1}\left(\dfrac{-1}{\sqrt{5}}\right) \approx 116.57°$

35. $|\mathbf{u}| = \sqrt{3^2 + (-4)^2} = 5, \alpha = 360° - \cos^{-1}\left(\dfrac{3}{5}\right)$
$\approx 306.87°$

36. $|\mathbf{u}| = \sqrt{(-3)^2 + (-5)^2} = \sqrt{34}$,
$\alpha = 360° - \cos^{-1}\left(\dfrac{-3}{\sqrt{34}}\right) \approx 239.04°$

37. Since $(7\cos 135°)\mathbf{i} + (7\sin 135°)\mathbf{j} = (|\mathbf{u}|\cos\alpha)\mathbf{i} + (|\mathbf{u}|\sin\alpha)\mathbf{j}$, $|\mathbf{u}| = 7$ and $\alpha = 135°$.

38. Since $(2\cos 60°)\mathbf{i} + (2\sin 60°)\mathbf{j} = (|\mathbf{u}|\cos\alpha)\mathbf{i} + (|\mathbf{u}|\sin\alpha)\mathbf{j}$, $|\mathbf{u}| = 2$ and $\alpha = 60°$.

For #39 and 40, first find the unit vector in the direction of $\mathbf{u}$. Then multiply by the magnitude of $\mathbf{v}$, $|\mathbf{v}|$.

39. $\mathbf{v} = |\mathbf{v}| \cdot \dfrac{\mathbf{u}}{|\mathbf{u}|} = 2\left\langle \dfrac{3}{\sqrt{3^2 + (-3)^2}}, \dfrac{-3}{\sqrt{3^2 + (-3)^2}} \right\rangle$
$= 2\left\langle \dfrac{\sqrt{2}}{2}, \dfrac{-\sqrt{2}}{2} \right\rangle = \langle \sqrt{2}, -\sqrt{2} \rangle$

40. $\mathbf{v} = |\mathbf{v}| \cdot \dfrac{\mathbf{u}}{|\mathbf{u}|} = 5\left\langle \dfrac{-5}{\sqrt{(-5)^2 + 7^2}}, \dfrac{7}{\sqrt{(-5)^2 + 7^2}} \right\rangle$
$\approx 5\langle -0.58, 0.81 \rangle = \langle -2.91, 4.07 \rangle$

41. A bearing of 335° corresponds to a direction angle of 115°. $\mathbf{v} = 530\langle \cos 115°, \sin 115° \rangle \approx \langle -223.99, 480.34 \rangle$.

42. A bearing of 170° corresponds to a direction angle of −80°. $\mathbf{v} = 460\langle \cos(-80°), \sin(-80°) \rangle \approx \langle 79.88, -453.01 \rangle$.

43. (a) A bearing of 340° corresponds to a direction angle of 110°. $\mathbf{v} = 325\langle \cos 110°, \sin 110° \rangle \approx \langle -111.16, 305.40 \rangle$.

(b) The wind bearing of 320° corresponds to a direction angle of 130°. The wind vector is $\mathbf{w} = 40\langle \cos 130°, \sin 130° \rangle \approx \langle -25.71, 30.64 \rangle$.
Actual velocity vector: $\mathbf{v} + \mathbf{w} \approx \langle -136.87, 336.04 \rangle$.
Actual speed: $\|\mathbf{v} + \mathbf{w}\| \approx \sqrt{136.87^2 + 336.04^2} \approx 362.84$ mph.