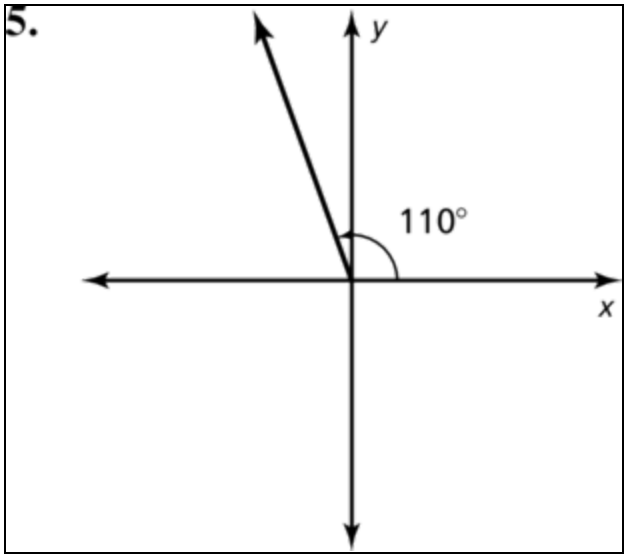
1. origin; initial side

2. When the angle is positive, its rotation is counterclockwise. When the angle is negative, its rotation is clockwise.

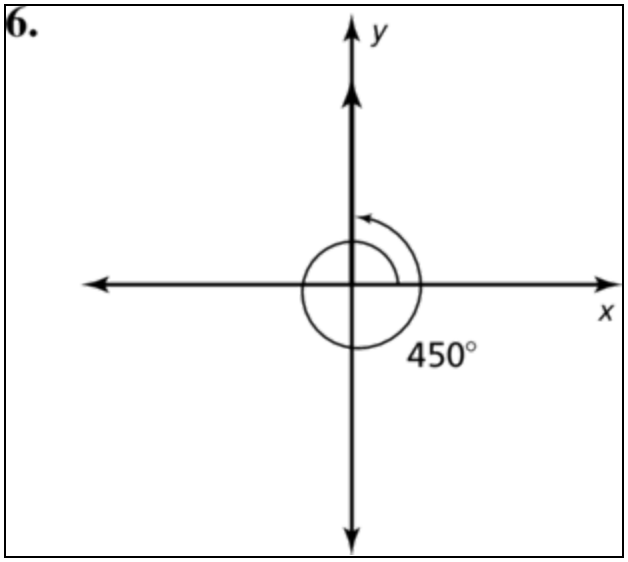
3. *Sample answer:* A radian is a measure of an angle that is approximately equal to $57.3°$ and there are 2π radians in a circle.

4. $-90°$; It has a different terminal side than the other three angles.

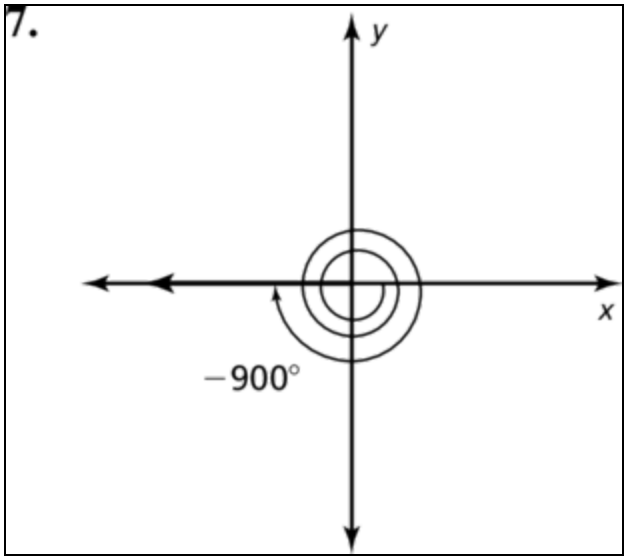
5.



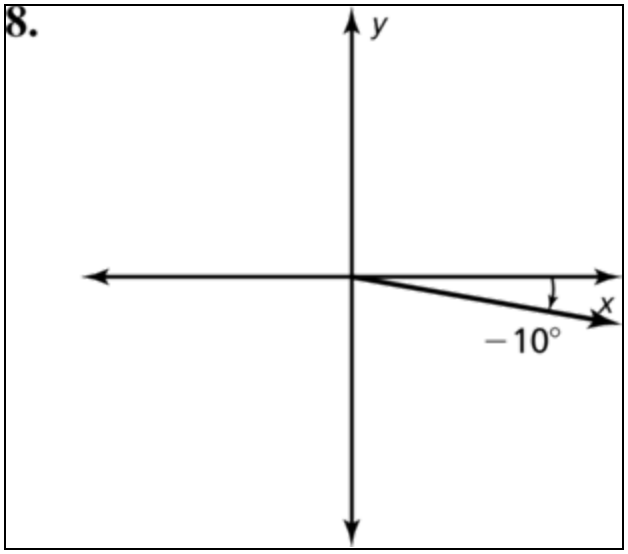
6.



7.



8.



9. $430^\circ; -290^\circ$

10. $615^\circ; -105^\circ$

11. $235^\circ; -485^\circ$

12. $280^\circ; -80^\circ$

13. $\frac{2\pi}{9}$

14. $\frac{7\pi}{4}$

15. $-\frac{13\pi}{9}$

16. $-\frac{25\pi}{9}$

17. $20°$

18. $135°$

19. about $-286.5°$

20. about $687.5°$

21. A full revolution is $360°$ or 2π radians. The terminal side rotates one-sixth of a revolution from the positive x-axis, so multiply by $\frac{1}{6}$ to get $\frac{1}{6} \cdot 360° = 60°$ and $\frac{1}{6} \cdot 2\pi = \frac{\pi}{3}$.

22. $\frac{15\pi}{4}$; $-\frac{\pi}{4}$; *Sample answer:* $315°$ is equivalent to $\frac{7\pi}{4}$ radians, and $\frac{7\pi}{4} + 2\pi = \frac{15\pi}{4}$ and $\frac{7\pi}{4} - 2\pi = -\frac{\pi}{4}$.

23. B

24. D

25. A

26. C

27. about 15.7 yd, about 78.5 yd^2

28. **a.** about 13.3 m
b. about 146 m^2

29. The wrong conversion was used;

$$24^\circ = 24 \text{ degrees}\left(\frac{\pi \text{ radians}}{180 \text{ degrees}}\right)$$

$$= \frac{24\pi}{180} \text{ radians}$$

$$\approx 0.42 \text{ radians}$$

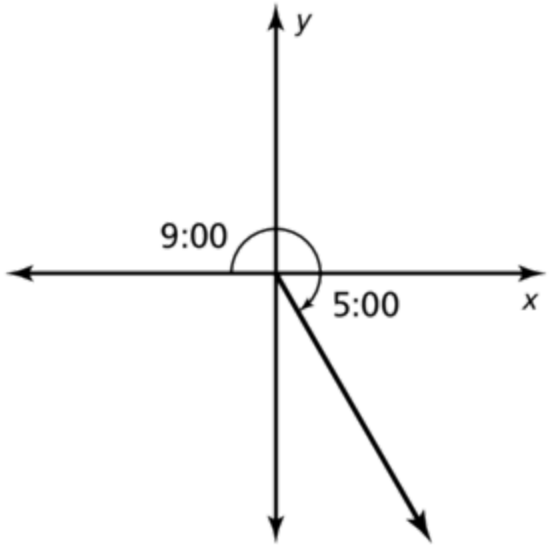
30. The angle was not converted to radians;

$$40^\circ = 40 \text{ degrees}\left(\frac{\pi \text{ radians}}{180 \text{ degrees}}\right) = \frac{2\pi}{9} \text{ radians}$$

$$A = \frac{1}{2}(6)^2\left(\frac{2\pi}{9}\right) \approx 12.57 \text{ cm}^2$$

31. $72{,}000^\circ, 400\pi$

32.



$240^\circ, \frac{4\pi}{3}$; *Sample answer:* The minute hand would generate an angle of 2880° or 16π.

33. -0.5

34. 0.383

35. 3.549

36. -1.376

37. -0.138

38. 0.960

39. 528 in.^{2}

40. **a.** $\frac{\pi}{2}$

b. about 45.6 ft

41. $60°, \frac{\pi}{3}$

42. $\pi - 1$; *Sample answer:* Using $s = r(\pi - \theta)$, the arc length of the small sector can be found to be 1. Therefore, $\pi - \theta = 1$ and $\theta = \pi - 1$.

43. about 6.89 in.^{2}, about 0.76 in.^{2}, about 0.46 in.^{2}

44. *Sample answer:* This continued fraction (which is irrational) gives rise to a sequence of rational approximations for π. When the next fraction is added, the value gets closer to the value of $\pi = 3.1415926535\ldots$, as shown.

$3 = 3$

$3 + \frac{1}{7} = \frac{22}{7} = 3.142857143\ldots$

$3 + \cfrac{1}{7 + \frac{1}{15}} = \frac{333}{106} = 3.141509434\ldots$

$3 + \cfrac{1}{7 + \cfrac{1}{15 + \frac{1}{1}}} = \frac{355}{113} = 3.141592920\ldots$

45. yes; When the arc length is equal to the radius, the equation $s = r\theta$ shows that $\theta = 1$ and $A = \frac{1}{2}r^2\theta$ is equivalent to $A = \frac{s^2}{2}$ for $r = s$ and $\theta = 1$.

46. **a.** about 16.49 in.

b. $\frac{15\pi}{8}$

c. about 5195.4 in.^{2}

47. **a.** $70°33'$

b. $110.76°$; $110 + \frac{45}{60} + \frac{30}{3600} \approx 110.76°$

48. about 2.83

49. about 27.02

50. 7

51. about 18.03

52. about 11.66

53. about 18.68