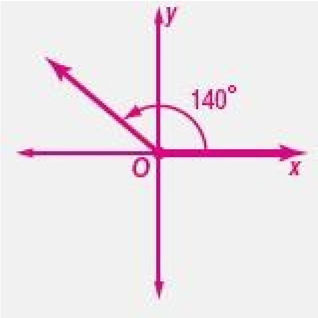
12-2 Angles and Angle Measure

1. 140º

SOLUTION:

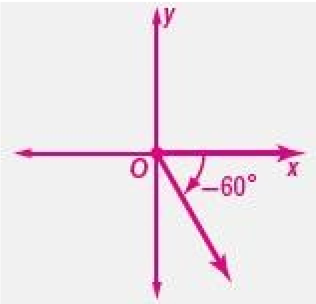
140º



2. –60º

SOLUTION:

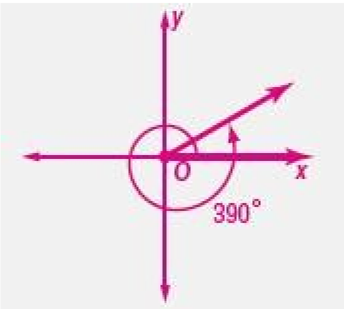
–60º



3. 390º

SOLUTION:

390º



Find an angle with a positive measure and an angle with a negative measure that are coterminal with each angle.

4. 25°

SOLUTION:

Positive angle: 25° + 360° = 385°
Negative angle: 25° – 360° = –335°

5. 175°

SOLUTION:

Positive angle: 175° + 360° = 535°
Negative angle: 175° – 360° = –185°

6. –100°

SOLUTION:

Positive angle: –100° + 360° = 260°
Negative angle: –100° – 360° = –460°

Rewrite each degree measure in radians and each radian measure in degrees.

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

SOLUTION:

$$\frac{\pi}{4} = \frac{\pi}{4}\text{radians} \cdot \frac{180^\circ}{\pi\,\text{radians}}$$
$$= \frac{180^\circ}{4}$$
$$= 45^\circ$$

8. 225°

SOLUTION:

$$\begin{aligned}225^\circ &= 225^\circ \cdot \frac{\pi \text{ radians}}{180^\circ}\\ &= \frac{225\pi}{180} \text{ or } \frac{5\pi}{4} \text{ radians}\end{aligned}$$

9. –40°

SOLUTION:

$$\begin{aligned}-40^\circ &= -40^\circ \cdot \frac{\pi \text{ radians}}{180^\circ}\\ &= -\frac{40\pi}{180} \text{ or } -\frac{2\pi}{9} \text{ radians}\end{aligned}$$

10. **CCSS REASONING** A tennis player's swing moves along the path of an arc. If the radius of the arc's circle is 4 feet and the angle of rotation is 100°, what is the length of the arc? Round to the nearest tenth.

SOLUTION:

Rewrite the central angle in radians.

$$\begin{aligned}100^\circ &= 100^\circ \cdot \frac{\pi \text{ radians}}{180^\circ}\\ &= \frac{100\pi}{180} \text{ radians}\\ &= \frac{5\pi}{9} \text{ radians}\end{aligned}$$

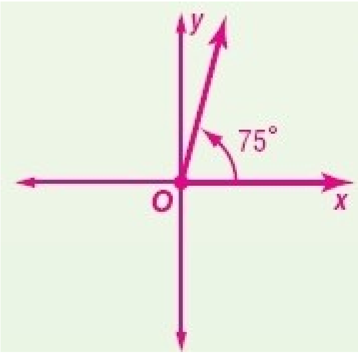
Substitute 4 for r and $\frac{5\pi}{9}$ for θ in the formula to find the arc length.

$$\begin{aligned}s &= r\theta\\ &= 4 \cdot \frac{5\pi}{9}\\ &= \frac{20\pi}{9}\\ &\approx 7.0 \text{ ft}\end{aligned}$$

Draw an angle with the given measure in standard position.

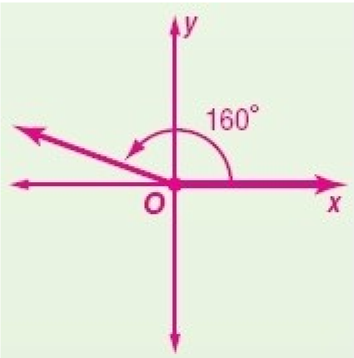
11. 75°

SOLUTION:
Draw the terminal side of the angle 75° counterclockwise.



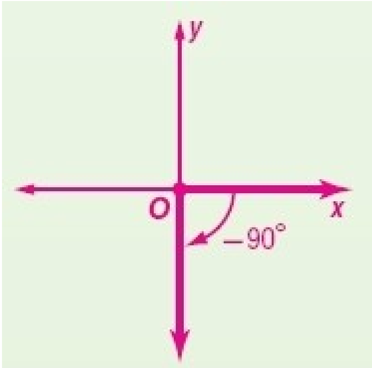
12. 160°

SOLUTION:
Draw the terminal side of the angle 160° counterclockwise.



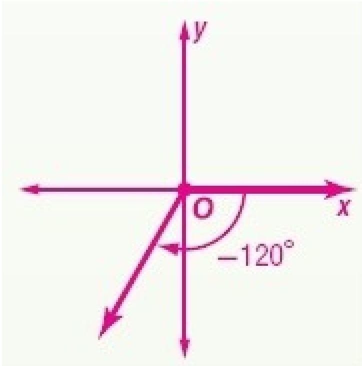
13. –90°

SOLUTION:
The angle is negative. Draw the terminal side of the angle 90° clockwise from the positive *x*-axis.



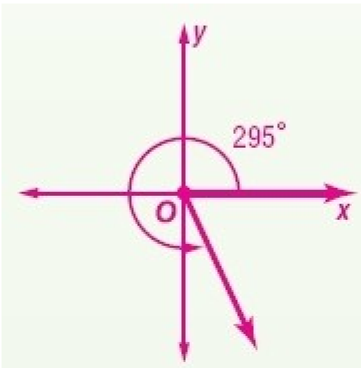
14. –120°

SOLUTION:
The angle is negative. Draw the terminal side of the angle 120° clockwise from the positive *x*-axis.



15. 295°

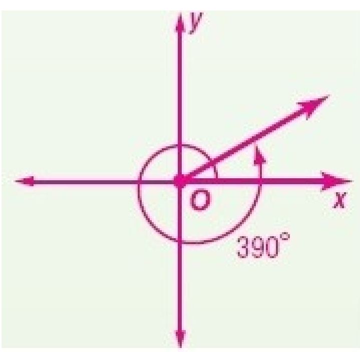
SOLUTION:
Draw the terminal side of the angle 295° counterclockwise.



16. 510°

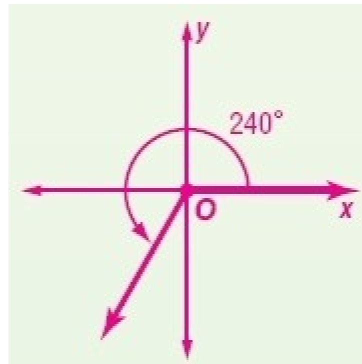
SOLUTION:
510° = 360° + 150°

Draw the terminal side of the angle 150° counterclockwise past the positive *x*-axis.



17. **GYMNASTICS** A gymnast on the uneven bars swings to make a 240° angle of rotation.

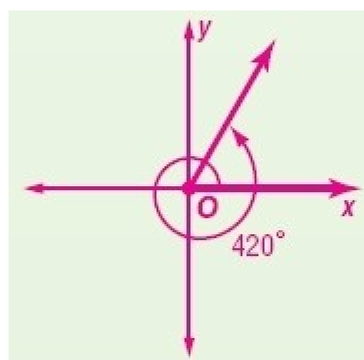
SOLUTION:
Draw the terminal side of the angle 240° counterclockwise.



18. **FOOD** The lid on a jar of pasta sauce is turned 420° before it comes off.

SOLUTION:
420° = 360° + 60°

Draw the terminal side of the angle 60° counterclockwise past the positive *x*-axis.



Find an angle with a positive measure and an angle with a negative measure that are coterminal with each angle.

19. 50°

SOLUTION:
Positive angle: 50° + 360° = 410°
Negative angle: 50° – 360° = –310°

20. 95°

SOLUTION:
Positive angle: 95° + 360° = 455°
Negative angle: 95° – 360° = –265°

21. 205°

SOLUTION:
Positive angle: 205° + 360° = 565°
Negative angle: 205° – 360° = –155°

22. 350°

SOLUTION:
Positive angle: 350° + 360° = 710°
Negative angle: 350° – 360° = –10°

23. −80°

SOLUTION:
Positive angle: –80° + 360° = 280°
Negative angle: 350° – 360° = –440°

24. −195°

SOLUTION:
Positive angle: –195° + 360° = 165°
Negative angle: –195° – 360° = –555°

Rewrite each degree measure in radians and each radian measure in degrees.

25. 330°

SOLUTION:

$$330^\circ = 330^\circ \cdot \frac{\pi \text{ radians}}{180^\circ} = \frac{330\pi}{180} \text{ or } \frac{11\pi}{6} \text{ radians}$$

26. $\frac{5\pi}{6}$

SOLUTION:

$$\frac{5\pi}{6} = \frac{5\pi}{6}\text{radians} \cdot \frac{180^\circ}{\pi \text{radians}} = \frac{900^\circ}{6} = 150^\circ$$

27. $-\frac{\pi}{3}$

SOLUTION:

$$-\frac{\pi}{3} = -\frac{\pi}{3}\text{radians} \cdot \frac{180^\circ}{\pi \text{radians}} = -\frac{180^\circ}{3} = -60^\circ$$

28. −50°

SOLUTION:

$$-50^\circ = -50^\circ \cdot \frac{\pi \text{ radians}}{180^\circ} = -\frac{50\pi}{180} \text{ or } -\frac{5\pi}{18} \text{ radians}$$

29. 190°

SOLUTION:

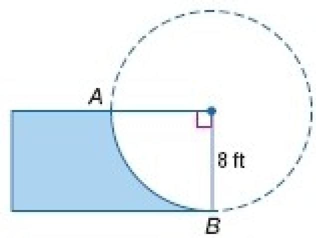
$$190^\circ = 190^\circ \cdot \frac{\pi \text{ radians}}{180^\circ} = \frac{190\pi}{180} \text{ or } \frac{19\pi}{18} \text{ radians}$$

30. $-\frac{7\pi}{3}$

SOLUTION:

$$-\frac{7\pi}{3} = -\frac{7\pi}{3}\text{radians} \cdot \frac{180^\circ}{\pi \text{radians}} = -\frac{1260^\circ}{3} = -420^\circ$$

31. **SKATEBOARDING** The skateboard ramp at the right is called a *quarter pipe*. The curved surface is determined by the radius of a circle. Find the length of the curved part of the ramp.



SOLUTION:

Rewrite the central angle in radians.

$$90^\circ = 90^\circ \cdot \frac{\pi \text{ radians}}{180^\circ} = \frac{90\pi}{180} \text{ radians} = \frac{\pi}{2} \text{ radians}$$

Substitute 8 for r and $\frac{\pi}{2}$ for θ in the formula to find the arc length.

$$s = r\theta = 8 \cdot \frac{\pi}{2} = 4\pi \approx 12.6 \text{ ft}$$

32. **RIVERBOATS** The paddlewheel of a riverboat has a diameter of 24 feet. Find the arc length of the circle made when the paddlewheel rotates 300°.

SOLUTION:

Rewrite the central angle in radians.

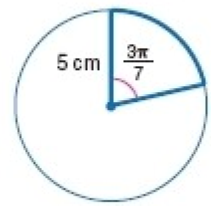
$$\begin{aligned} 300^\circ &= 300^\circ \cdot \frac{\pi \text{ radians}}{180^\circ} \\ &= \frac{300\pi}{180} \text{ radians} \\ &= \frac{5\pi}{3} \text{ radians} \end{aligned}$$

$$\begin{aligned} \text{Radius} &= \frac{24}{2} \\ &= 12 \end{aligned}$$

Substitute 12 for r and $\frac{5\pi}{3}$ for θ in the formula to find the arc length.

$$\begin{aligned} s &= r\theta \\ &= 12 \cdot \frac{5\pi}{3} \\ &= 20\pi \\ &\approx 62.8 \text{ ft} \end{aligned}$$

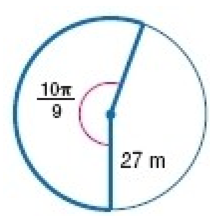
Find the length of each arc. Round to the nearest tenth.

33. 

SOLUTION:

Substitute 5 for r and $\frac{3\pi}{7}$ for θ in the formula to find the arc length.

$$\begin{aligned} s &= r\theta \\ &= 5 \cdot \frac{3\pi}{7} \\ &= \frac{15\pi}{7} \\ &= 6.7 \text{ cm} \end{aligned}$$

34. 

SOLUTION:

Substitute 27 for r and $\frac{10\pi}{9}$ for θ in the formula to find the arc length.

$$\begin{aligned} s &= r\theta \\ &= 27 \cdot \frac{10\pi}{9} \\ &= \frac{270\pi}{9} \\ &= 30\pi \\ &= 94.2 \text{ m} \end{aligned}$$

35. **CLOCKS** How long does it take for the minute hand on a clock to pass through 2.5π radians?

SOLUTION:
Rewrite the radian measure in degrees.

$$2.5\pi = 2.5\pi \text{ radians} \cdot \frac{180^\circ}{\pi \text{ radians}}$$
$$= 450^\circ$$

450° = 360° + 90°

Rotation of 360° makes an hour and rotation of 90° makes 15 minutes.
So, the minute hand takes 1 hour and 15 minutes to pass through 2.5π radians.

36. **CCSS PERSEVERANCE** Refer to the beginning of the lesson. A shadow moves around a sundial 15° every hour.

a. After how many hours is the angle of rotation of the shadow $\frac{8\pi}{5}$ radians?

b. What is the angle of rotation in radians after 5 hours?

c. A sundial has a radius of 8 inches. What is the arc formed by a shadow after 14 hours? Round to the nearest tenth.

SOLUTION:
a. Rewrite the radian measure in degrees.

$$\frac{8\pi}{5} = \frac{8\pi}{5} \text{radians} \cdot \frac{180^\circ}{\pi \text{ radians}}$$
$$= 288^\circ$$

For every hour the shadow moves 15° around a sundial.
So 288° rotation takes $\frac{288}{15}$ hours or 19.2 hours.

b. Let *x* represents the angle of rotation (in radians) after 5 hours.

The equation that represents the situation is $\frac{\frac{8\pi}{5}}{x} = \frac{19.2}{5}$.

$$\frac{8\pi}{5x} = \frac{19.2}{5}$$
$$40\pi = 96x$$
$$x = \frac{40\pi}{96}$$
$$x = \frac{5\pi}{12}$$

c. Let *x* represents the angle of rotation after 14 hours.

The equation that represents the situation is $\frac{\frac{8\pi}{5}}{x} = \frac{19.2}{14}$.

$$\frac{8\pi}{5x} = \frac{19.2}{14}$$
$$112\pi = 96x$$
$$x = \frac{112\pi}{96}$$
$$x = \frac{7\pi}{6}$$

Substitute 8 for *r* and $\frac{7\pi}{6}$ for θ in the formula to find the arc length.

$$s = r\theta$$
$$= 8 \cdot \frac{7\pi}{6}$$
$$\approx 29.3 \text{ in}$$

Find an angle with a positive measure and an angle with a negative measure that are coterminal with each angle.

37. 620°

SOLUTION:

Positive angle: 620° – 360° = 260°
Negative angle: 620° – 2(360°) = –100°

38. −400°

SOLUTION:

Positive angle: –400° + 2(360°) = 320°
Negative angle: –400° + 360° = –40°

39. $-\frac{3\pi}{4}$

SOLUTION:

Positive angle: $-\frac{3\pi}{4}+2\pi=\frac{5\pi}{4}$

Negative angle: $-\frac{3\pi}{4}-2\pi=-\frac{11\pi}{4}$

40. $\frac{19\pi}{6}$

SOLUTION:

Positive angle: $\frac{19\pi}{6}-2\pi=\frac{7\pi}{6}$

Negative angle: $\frac{19\pi}{6}-2(2\pi)=-\frac{5\pi}{6}$

41. **SWINGS** A swing has a 165° angle of rotation.

a. Draw the angle in standard position.

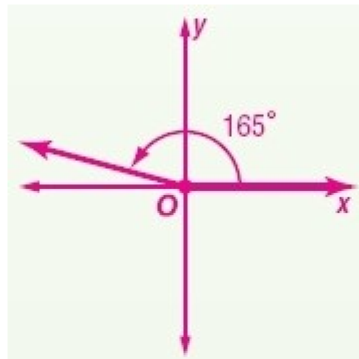
b. Write the angle measure in radians.

c. If the chains of the swing are $6\frac{1}{2}$ feet long, what is the length of the arc that the swing makes? Round to the nearest tenth.

d. Describe how the arc length would change if the lengths of the chains of the swing were doubled.

SOLUTION:

a. Draw the terminal side of the angle 165° counterclockwise.



b.

$$165^\circ = 165^\circ \cdot \frac{\pi \text{ radians}}{180^\circ} = \frac{165\pi}{180} \text{ or } \frac{11\pi}{12} \text{radians}$$

c. Substitute $6\frac{1}{2}$ for r and $\frac{11\pi}{12}$ for θ in the formula to find the arc length.

$$\begin{aligned} s &= r\theta \\ &= 6\frac{1}{2}\cdot\frac{11\pi}{12} \\ &= \frac{13}{2}\cdot\frac{11\pi}{12} \\ &\approx 18.7 \text{ ft} \end{aligned}$$

d. The arc length would double. Since $s = r\theta$, if r is doubled and θ remains unchanged, then the value of s is also doubled.

42. **MULTIPLE REPRESENTATIONS** Consider *A*(−4, 0), *B*(−4, 6), *C*(6, 0), and *D*(6, 8).

a. GEOMETRIC Draw Δ*EAB* and Δ*ECD* with *E* at the origin.

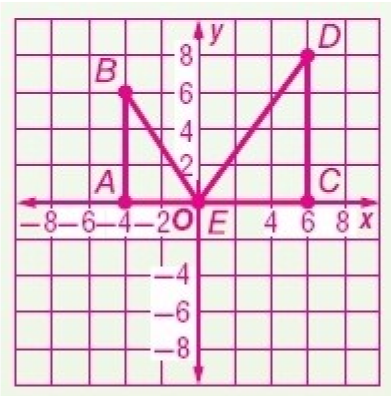
b. ALGEBRAIC Find the values of the tangent of ΔBEA and the tangent of ΔDEC.

c. ALGEBRAIC Find the slope of $\overline{BE}$ and $\overline{ED}$

d. VERBAL What conclusions can you make about the relationship between slope and tangent?

SOLUTION:

a.
Plot the given coordinates and *E* at the origin and join them to form the triangles ΔEAB and ΔECD.



b.

$$\overline{BA} = 6 - 0 = 6$$
$$\overline{EA} = 0 - 4 = -4$$
$$\overline{DC} = 8 - 0 = 8$$
$$\overline{EC} = 6 - 0 = 6$$

$$\tan\angle BEA = -\frac{6}{4} = -\frac{3}{2}$$
$$\tan\angle DEC = \frac{8}{6} = \frac{4}{3}$$

c. Consider the endpoints (–4, 6) and (0, 0) of $\overline{BE}$.

$$\text{Slope} = \frac{y_2 - y_1}{x_2 - x_1}$$
$$\text{Slope of } \overline{BE} = \frac{0-6}{0+4} = -\frac{3}{2}$$

Consider the endpoints (6, 8) and (0, 0) of $\overline{ED}$.

$$\text{Slope} = \frac{y_2 - y_1}{x_2 - x_1}$$
$$\text{Slope of } \overline{ED} = \frac{0-8}{0-6} = \frac{4}{3}$$

d. Sample answer: In the coordinate plane, the tangent of the angle in standard position equals the slope of the terminal side of the angle.

Rewrite each degree measure in radians and each radian measure in degrees.

43. $\frac{21\pi}{8}$

SOLUTION:

$$\frac{21\pi}{8} = \frac{21\pi}{8}\text{radians} \cdot \frac{180^\circ}{\pi\,\text{radians}} = \frac{3780^\circ}{8} = 472.5^\circ$$

44. 124°

SOLUTION:

$$124^\circ = 124^\circ \cdot \frac{\pi\text{ radians}}{180^\circ} = \frac{124\pi}{180} \text{ or } \frac{31\pi}{45}\text{radians}$$

45. $-200°$

SOLUTION:

$$-200° = -200° \cdot \frac{\pi \text{ radians}}{180°}$$
$$= -\frac{200\pi}{180} \text{ or } -\frac{10\pi}{9} \text{ radians}$$

46. 5

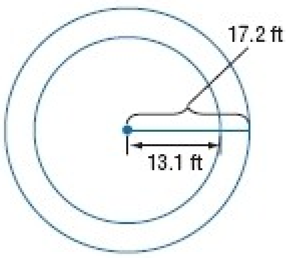
SOLUTION:

$$5 = 5 \text{ radians} \cdot \frac{180°}{\pi \text{ radians}}$$
$$= \frac{900°}{\pi}$$
$$\approx 286.5°$$

47. **CAROUSELS** A carousel makes 5 revolutions per minute. The circle formed by riders sitting in the outside row has a radius of 17.2 feet. The circle formed by riders sitting in the inside row has a radius of 13.1 feet.

a. Find the angle θ in radians through which the carousel rotates in one second.

b. In one second, what is the difference in arc lengths between the riders sitting in the outside row and the riders sitting in the inside row?



SOLUTION:

a. One revolution makes 360°, so 5 revolutions make 1800°(360° × 5).
For the rotation of 1800° it takes 60 seconds.

Therefore, for one sec it makes $\frac{1800}{60}$ or 30° angle of rotation.

Rewrite 30° in radians.

$$30° = 30° \cdot \frac{\pi \text{ radians}}{180°}$$
$$= \frac{30\pi}{180} \text{ or } \frac{\pi}{6} \text{ radians}$$

Substitute 17.2 for r and $\frac{\pi}{6}$ for θ in the formula to find the arc length.

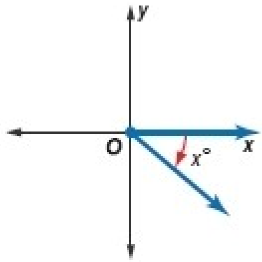
$$s = r\theta$$
$$= 17.2 \cdot \frac{\pi}{6}$$
$$\approx 9 \text{ ft}$$

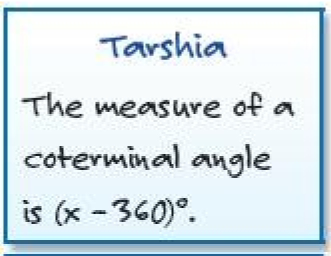
Substitute 13.1 for r and $\frac{\pi}{6}$ for θ in the formula to find the arc length.

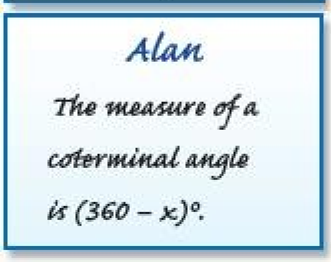
$$s = r\theta$$
$$= 13.1 \cdot \frac{\pi}{6}$$
$$\approx 6.9 \text{ ft}$$

The difference in arc lengths between the riders sitting in the outside row and the riders sitting in the inside row is 2.1 ft(9 – 6.9).

48. **CCSS CRITIQUE** Tarshia and Alan are writing an expression for the measure of an angle coterminal with the angle shown. Is either of them correct? Explain your reasoning.





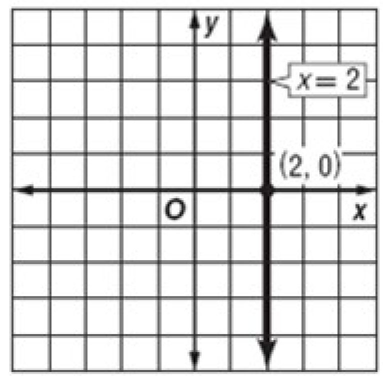


SOLUTION:

Tarshia is correct; a coterminal angle can be found by adding a multiple of 360° or by subtracting a multiple of 360°. Alan incorrectly subtracted the original angle measure from 360°.

49. **CHALLENGE** A line makes an angle of $\frac{\pi}{2}$ radians with the positive x-axis at the point (2, 0). Find an equation for this line.

SOLUTION:



The equation of the line is $x = 2$.

50. **REASONING** Express $\frac{1}{8}$ of a revolution in degrees and in radians. Explain your reasoning.

SOLUTION:

$\frac{1}{8}$ of a revolution is 45° or $\frac{\pi}{4}$.

One revolution makes 360° or 2π radians.

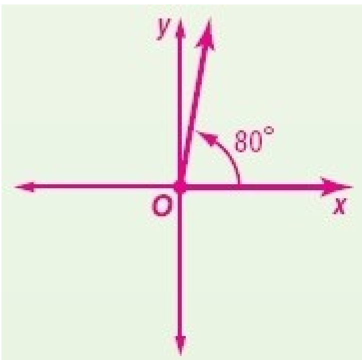
$\frac{1}{8}$ of a revolution in degrees $= \frac{1}{8} \cdot 360$ or 45

$\frac{1}{8}$ of a revolution in radians $= \frac{1}{8} \cdot 2\pi$ or $\frac{\pi}{4}$

51. **OPEN ENDED** Draw and label an acute angle in standard position. Find two angles, one positive and one negative, that are coterminal with the angle.

SOLUTION:

Sample answer:



Positive angle: 80° + 360° = 440°
Negative angle: 80° – 360° = –280°

52. **REASONING** Justify the formula for the length of an arc.

SOLUTION:

Use a proportion.

$$\frac{\text{measure of the central angle}}{\text{measure of an entire circle}} = \frac{\text{the length of the arc}}{\text{the circumference}}$$

$\frac{\theta}{2\pi} = \frac{s}{2\pi r}$ Substitute.

$2\pi r\theta = 2\pi s$ Find the cross products.

$r\theta = s$ Divide each side by 2π.

53. **WRITING IN MATH** Use a circle with radius r to describe what one degree and one radian represent. Then explain how to convert between the measures.

SOLUTION:

One degree represents an angle measure that equals $\frac{1}{360}$ rotation around a circle. One radian represents the measure of an angle in standard position that intercepts an arc of length r. To change from degrees to radians, multiply the number of degrees by $\frac{\pi \text{ radians}}{180°}$. To change from radians to degrees, multiply the number of radians by $\frac{180°}{\pi \text{ radians}}$.

54. **SHORT RESPONSE** If $(x + 6)(x + 8) - (x - 7)(x - 5) = 0$, find x.

SOLUTION:

$$(x+6)(x+8)-(x-7)(x-5)=0$$
$$(x^2+14x+48)-(x^2-12x+35)=0$$
$$x^2+14x+48-x^2+12x-35=0$$
$$26x+13=0$$
$$26x=-13$$
$$x=-\frac{13}{26}$$
$$x=-\frac{1}{2}$$

55. Which of the following represents an inverse variation?

A

x	2	5	10	20	25	50
y	50	20	10	5	4	2

B

x	2	4	6	8	10	12
y	−4	−8	−12	−16	−20	−24

C

x	1	2	3	4	5	6
y	5	10	15	20	25	30

D

x	10	9	8	7	6	5
y	5	6	7	8	9	10

SOLUTION:

Consider the option A.

$(x_1, y_1) = (2, 50)$

$(x_2, y_2) = (5, 20)$

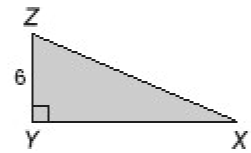
Use a proportion that relates the values.

$$\frac{y_1}{x_2} = \frac{y_2}{x_1} \quad \text{Indirect variation}$$
$$\frac{50}{5} = \frac{20}{2}$$
$$10 = 10 \checkmark$$

Thus, option A represents an inverse variation.

A is the correct option.

56. **GEOMETRY** If the area of the figure is 60 square units, what is the length of side $\overline{XZ}$?



F $2\sqrt{34}$

G $2\sqrt{109}$

H $4\sqrt{109}$

J $4\sqrt{34}$

SOLUTION:

Let the base of the triangle be *x*.
Substitute 6 for height, *x* for base and 60 for area in the area formula.

$$\text{Area of a triangle} = \frac{1}{2} \cdot \text{base} \cdot \text{height}$$
$$60 = \frac{1}{2}(x)(6)$$
$$60 = 3x$$
$$x = \frac{60}{3}$$
$$x = 20$$

Use the Pythagorean equation to find the other side of the triangle.

$$c^2 = a^2 + b^2$$
$$c^2 = 6^2 + 20^2$$
$$c^2 = 436$$
$$c = \sqrt{436}$$
$$c = 2\sqrt{109}$$

G is the correct option.]

57. **SAT/ACT** The first term of a sequence is −6, and every term after the first is 8 more than the term immediately preceding it. What is the value of the 101st term?

A 788

B 794

C 802

D 808

E 814

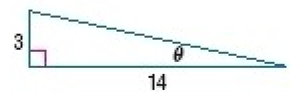
SOLUTION:

Substitute $a_1 = -6$, $d = 8$ and $n = 101$ in the formula to find nth term.

$$a_n = a_1 + (n-1)d$$
$$a_n = -6 + (101-1)8$$
$$= -6 + 800$$
$$= 794$$

B is the correct option.

Find the values of the six trigonometric functions for angle θ.

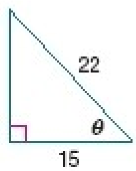
58. 

SOLUTION:

Use the Pythagorean equation to find the unknown side of the triangle.

$$c^2 = a^2 + b^2$$
$$c^2 = 3^2 + 14^2$$
$$c^2 = 205$$
$$c = \sqrt{205}$$

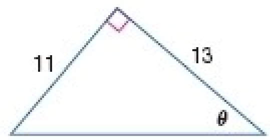
$$\sin\theta = \frac{\text{opp}}{\text{hyp}} = \frac{3}{\sqrt{205}} \text{ or } \frac{3\sqrt{205}}{205}$$
$$\cos\theta = \frac{\text{adj}}{\text{hyp}} = \frac{14}{\sqrt{205}} \text{ or } \frac{14\sqrt{205}}{205}$$
$$\tan\theta = \frac{\text{opp}}{\text{adj}} = \frac{3}{14}$$
$$\csc\theta = \frac{\text{hyp}}{\text{opp}} = \frac{\sqrt{205}}{3}$$
$$\sec\theta = \frac{\text{hyp}}{\text{adj}} = \frac{\sqrt{205}}{14}$$
$$\cot\theta = \frac{\text{adj}}{\text{opp}} = \frac{14}{3}$$

59. 

SOLUTION:
Use the Pythagorean equation to find the unknown side of the triangle.

$$c^2 = a^2 + b^2$$
$$22^2 = a^2 + 15^2$$
$$484 = a^2 + 225$$
$$a^2 = 259$$
$$a = \sqrt{259}$$

$$\sin\theta = \frac{\text{opp}}{\text{hyp}} = \frac{\sqrt{259}}{22}$$
$$\cos\theta = \frac{\text{adj}}{\text{hyp}} = \frac{15}{22}$$
$$\tan\theta = \frac{\text{opp}}{\text{adj}} = \frac{\sqrt{259}}{15}$$
$$\csc\theta = \frac{\text{hyp}}{\text{opp}} = \frac{22}{\sqrt{259}} \text{ or } \frac{22\sqrt{259}}{259}$$
$$\sec\theta = \frac{\text{hyp}}{\text{adj}} = \frac{22}{15}$$
$$\cot\theta = \frac{\text{adj}}{\text{opp}} = \frac{15}{\sqrt{259}} \text{ or } \frac{15\sqrt{259}}{259}$$

60. 

SOLUTION:
Use the Pythagorean equation to find the unknown side of the triangle.

$$c^2 = a^2 + b^2$$
$$c^2 = 13^2 + 11^2$$
$$c^2 = 290$$
$$c = \sqrt{290}$$

$$\sin\theta = \frac{\text{opp}}{\text{hyp}} = \frac{11}{\sqrt{290}} \text{ or } \frac{11\sqrt{290}}{290}$$
$$\cos\theta = \frac{\text{adj}}{\text{hyp}} = \frac{13}{\sqrt{290}} \text{ or } \frac{13\sqrt{290}}{290}$$
$$\tan\theta = \frac{\text{opp}}{\text{adj}} = \frac{11}{13}$$
$$\csc\theta = \frac{\text{hyp}}{\text{opp}} = \frac{\sqrt{290}}{11}$$
$$\sec\theta = \frac{\text{hyp}}{\text{adj}} = \frac{\sqrt{290}}{13}$$
$$\cot\theta = \frac{\text{adj}}{\text{opp}} = \frac{13}{11}$$

Identify the null and alternative hypotheses for each statement. Then identify the statement that represents the claim.

61. Tom drinks at least eight glasses of water every day.

SOLUTION:
at least 8 glasses: $\mu \geq 8$
less than 8 glasses: $\mu < 8$

The claim is $\mu \geq 8$, and it is the null hypothesis because it does include equality. The alternative hypothesis is $\mu < 8$, which is the complement of $\mu \geq 8$.

$H_0: \mu \geq 8$ (claim)
$H_a: \mu < 8$

62. Juanita says that she has two umbrellas in her car.

SOLUTION:
2 umbrellas: $\mu = 2$
not 2 umbrellas: $\mu \neq 2$

The claim is $\mu = 2$, and it is the null hypothesis because it does include equality. The alternative hypothesis is $\mu \neq 2$, which is the complement of $\mu = 2$.

$H_0: \mu = 2$ (claim)
$H_a: \mu \neq 2$

63. **MANUFACTURING** The sizes of CDs made by a company are normally distributed with a standard deviation of 1 millimeter. The CDs are supposed to be 120 millimeters in diameter, and they are made for drives that are 122 millimeters wide.

a. What percent of the CDs would you expect to be greater than 120 millimeters?

b. If the company manufactures 1000 CDs per hour, how many of the CDs made in one hour would you expect to be between 119 and 122 millimeters?

c. About how many CDs per hour will be too large to fit in the drives?

SOLUTION:
a. Given $\mu = 120$ and $\sigma = 1$.
The percent of the CDs would you expect to be greater than 120 millimeters is
$P(x > 120) = 34\% + 13.5\% + 2\% + 0.5\% = 50\%$.

b. Given $\mu = 120$ and $\sigma = 1$.
The probability of CDs that was made in one hour would be between 119 and 122 millimeters $\mu - \sigma$ and $\mu + 2\sigma$, that is, between 120 – 1 or 119 and 120 + 2(1) or 122.
$P(119 < x < 122) = 34\% + 34\% + 13.5\% = 81.5\%$
81.5% of 1000 CDs = 815 CDs

c. Given $\mu = 120$ and $\sigma = 1$.
The probability CDs that will be too large to fit in the drives is greater than $\mu + 2\sigma$, that is, 120 + 2(1) or 122.
$P(x > 122) = 2\% + 0.5\% = 2.5\%$
2.5% of 1000 CDs = 25 CDs

64. **FINANCIAL LITERACY** If the rate of inflation is 2%, the cost of an item in future years can be found by iterating the function $c(x) = 1.02x$. Find the cost of a $70 digital audio player in four years if the rate of inflation remains constant.

SOLUTION:
Given $a_1 = 70$, $r = 1.02$ and $n = 5$

$$\begin{aligned} a_n &= a_1 r^{n-1} \\ a_5 &= 70(1.02)^{5-1} \\ &= 70(1.02)^4 \\ &= 75.77 \end{aligned}$$

Use the Pythagorean Theorem to find the length of the hypotenuse for each right triangle with the given side lengths.

65. $a = 12$, $b = 15$

SOLUTION:
Substitute 12 for a and 15 for b in the Pythagorean equation and solve for c.

$$\begin{aligned} c^2 &= a^2 + b^2 \\ c^2 &= 12^2 + 15^2 \\ c^2 &= 369 \\ c &= \sqrt{369} \\ c &= 3\sqrt{41} \end{aligned}$$

66. $a = 8$, $b = 17$

SOLUTION:
Substitute 8 for a and 17 for b in the Pythagorean equation and solve for c.

$$\begin{aligned} c^2 &= a^2 + b^2 \\ c^2 &= 8^2 + 17^2 \\ c^2 &= 353 \\ c &= \sqrt{353} \end{aligned}$$

67. $a = 14$, $b = 11$

SOLUTION:
Substitute 14 for a and 11 for b in the Pythagorean equation and solve for c.

$$\begin{aligned} c^2 &= a^2 + b^2 \\ c^2 &= 14^2 + 11^2 \\ c^2 &= 317 \\ c &= \sqrt{317} \end{aligned}$$