key

Practice 13-3

Radian Measure

Part One

Write each measure in radians. Express your answer in terms of π.

1. 150°
$\frac{150^\circ}{1} \cdot \frac{\pi}{180^\circ} = \frac{5\pi}{6}$

2. 360°
$\frac{360^\circ}{1} \times \frac{\pi}{180^\circ} = 2\pi$

3. 220°
$\frac{220^\circ}{1} \times \frac{\pi}{180^\circ} = \frac{11\pi}{9}$

4. 270°
$\frac{270^\circ}{1} \times \frac{\pi}{180^\circ} = \frac{3\pi}{2}$

5. 300°
$\frac{300^\circ}{1} \times \frac{\pi}{180^\circ} = \frac{5\pi}{3}$

6. 160°
$\frac{160^\circ}{1} \times \frac{\pi}{180^\circ} = \frac{8\pi}{9}$

7. 40°
$\frac{40^\circ}{1} \times \frac{\pi}{180^\circ} = \frac{2\pi}{9}$

8. 80°
$\frac{80^\circ}{1} \times \frac{\pi}{180^\circ} = \frac{4\pi}{9}$

9. 110°
$\frac{110^\circ}{1} \times \frac{\pi}{180^\circ} = \frac{11\pi}{18}$

10. 200°
$\frac{200^\circ}{1} \times \frac{\pi}{180^\circ} = \frac{10\pi}{9}$

Write each measure in degrees. Round your answer to the nearest degree, if necessary.

11. 2π radians
$\frac{2\pi}{1} \times \frac{180^\circ}{\pi} = 360^\circ$

12. $\frac{5\pi}{6}$ radians
$\frac{5\pi}{6} \times \frac{180^\circ}{\pi} = 150^\circ$

13. -3 radians
$\frac{-3}{1} \times \frac{180^\circ}{\pi} = \frac{-540}{\pi} = -172^\circ$

14. $\frac{7\pi}{4}$ radians
$\frac{7\pi}{4} \times \frac{180^\circ}{\pi} = 315^\circ$

15. 1.57 radians
$\frac{1.57}{1} \times \frac{180^\circ}{\pi} = \frac{282.6^\circ}{\pi} = 90^\circ$

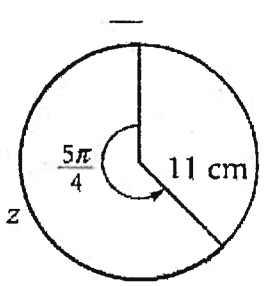
16. $\frac{2\pi}{9}$ radians
$\frac{2\pi}{9} \times \frac{180^\circ}{\pi} = 40^\circ$

17. $\frac{11\pi}{6}$ radians
$\frac{11\pi}{6} \cdot \frac{180^\circ}{\pi} = 330^\circ$

18. $\frac{4\pi}{3}$ radians
$\frac{4\pi}{3} \cdot \frac{180^\circ}{\pi} = 240^\circ$

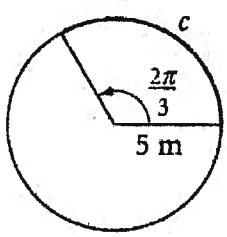
Use each circle to find the length of the indicated arc. Round your answer to the nearest tenth.

19.



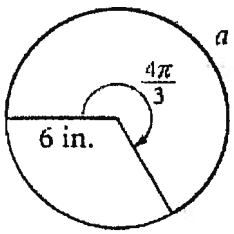
$z = \frac{5\pi}{4} \cdot 11$
$= \frac{55\pi}{4}$
$= 43.2$ cm

20.



$C = \frac{2\pi}{3} \cdot \frac{5}{1} = \frac{10\pi}{3}$
$= 10.5$ M

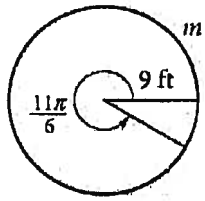
21.



$a = \frac{4\pi}{3} \cdot \frac{6}{1}$

$= \frac{24\pi}{3} = 25.1$ in.

22.



$m = \frac{11\pi}{6} \cdot 9 = \frac{99\pi}{6}$

$= 51.8$ ft.

23. A pendulum swings through an angle of 1.8 radians. The distance the tip of the pendulum travels is 32 in. How long is the pendulum?

$S = 32$ in

$\theta = 1.8$ rad

$S = \theta \cdot r$

$32 = 1.8 \cdot r$

$r = 18$ in

24. A 0.8 m pendulum swings through an angle of 1.5 radians. What distance does the tip of the pendulum travel?

$r = 0.8$

$\theta = 1.5$

$S = \theta \cdot r$

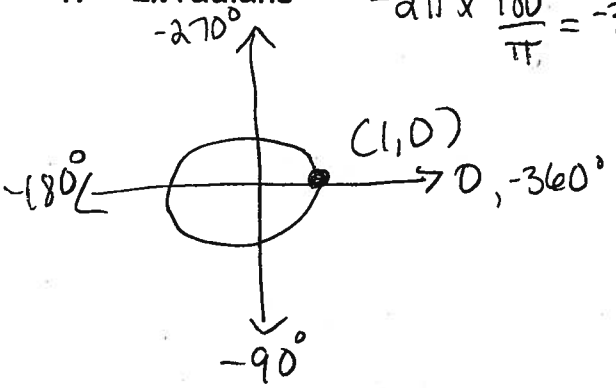
$S = 0.8 \times 1.5$

$= 1.2$ m

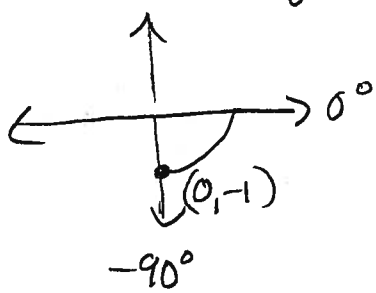
Lesson 13.3 Part Two

The measure θ of an angle in standard position is given. Draw the reference triangle and find the exact values of cos θ and sin θ for each angle measure.

1. **-2π radians** $-2\pi \times \frac{180^\circ}{\pi} = -360^\circ$



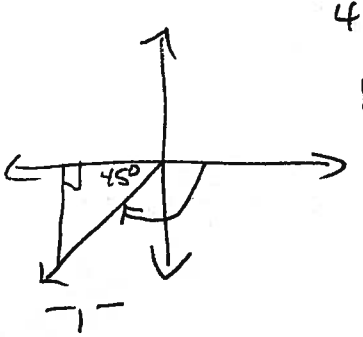
2. **$-\frac{\pi}{2}$ radians** $-\frac{\pi}{2} \cdot \frac{180^\circ}{\pi} = -90$



3. **$-\frac{3\pi}{4}$ radians** $-\frac{3\pi}{4} \cdot \frac{180^\circ}{\pi} = -135^\circ$

ref $\measuredangle = 45^\circ$

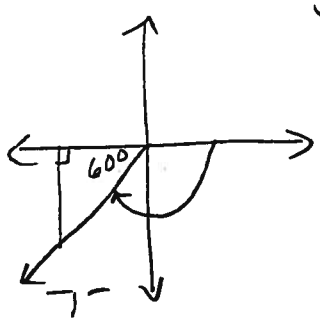
$\left(-\frac{\sqrt{2}}{2}, -\frac{\sqrt{2}}{2}\right)$



4. **$-\frac{2\pi}{3}$ radians** $-\frac{2\pi}{3} \cdot \frac{180^\circ}{\pi} = -120^\circ$

ref $\measuredangle = 60^\circ$

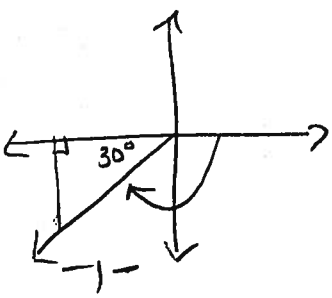
$\left(-\frac{1}{2}, -\frac{\sqrt{3}}{2}\right)$



5. **$-\frac{5\pi}{6}$ radians** $-\frac{5\pi}{6} \cdot \frac{180^\circ}{\pi} = -150^\circ$

ref $\measuredangle = 30^\circ$

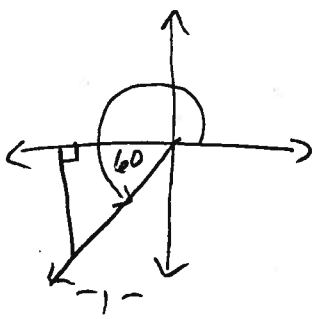
$\left(-\frac{\sqrt{3}}{2}, -\frac{1}{2}\right)$



6. **$\frac{4\pi}{3}$ radians** $\frac{4\pi}{3} \cdot \frac{180^\circ}{\pi} = 240^\circ$

ref $\measuredangle = 60^\circ$

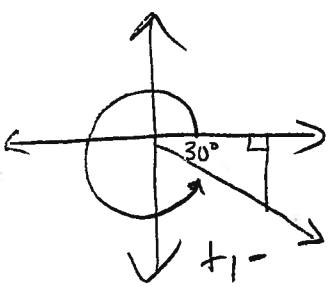
$\left(-\frac{1}{2}, -\frac{\sqrt{3}}{2}\right)$



7. **$\frac{11\pi}{6}$ radians** $\frac{11\pi}{6} \cdot \frac{180^\circ}{\pi} = 330^\circ$

ref $\measuredangle = 30^\circ$

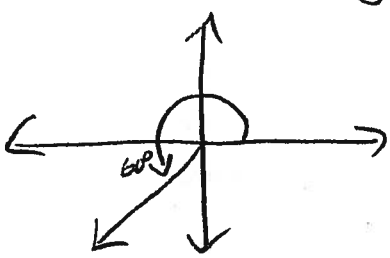
$\left(\frac{\sqrt{3}}{2}, -\frac{1}{2}\right)$



In which quadrant, or on which axis, does the terminal side of each angle lie? Draw the reference angle.

8. $\frac{4\pi}{3}$ radians

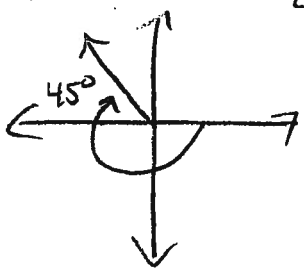
$\frac{4\pi}{3} \cdot \frac{180^\circ}{\pi} = 240^\circ$



Quad III

9. $-\frac{5\pi}{4}$ radians

$\frac{-5\pi}{4} \cdot \frac{180^\circ}{\pi} = -225^\circ$

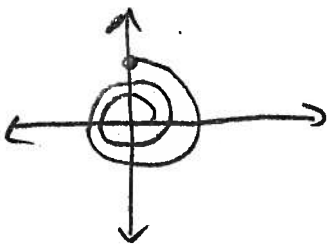


Quad II

10. $\frac{9\pi}{2}$ radians

$\frac{9\pi}{2} \cdot \frac{180^\circ}{\pi} = 810^\circ$

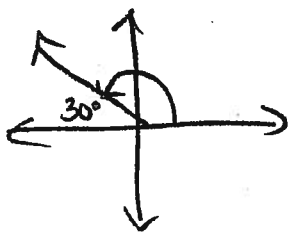
810°
-360
450
-360°
90°



positive y-axis

11. $\frac{5\pi}{6}$ radians

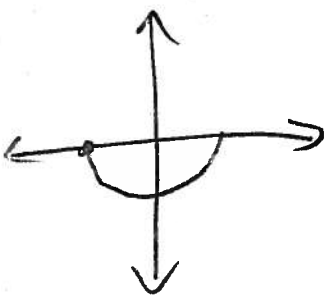
$\frac{5\pi}{6} \cdot \frac{180}{\pi} = 150^\circ$



Quad II

12. $-\pi$ radians

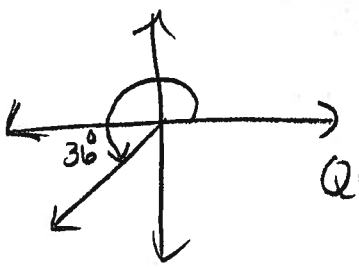
$-\pi \cdot \frac{180^\circ}{\pi} = -180^\circ$



negative x-axis

13. $\frac{6\pi}{5}$ radians

$\frac{6\pi}{5} \cdot \frac{180^\circ}{\pi} = 216^\circ$



Quad III