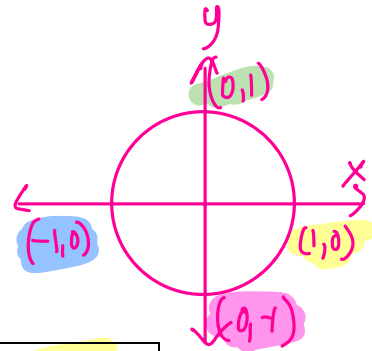Do Now

1. For each quadrant below, determine if the sine, cosine and tangent of an angle whose terminal ray falls in the quadrant is positive (+) or negative (−).

QII   QI

S   A

T   C

QIII   QIV

	I	II	III	IV
$\cos(\theta)$	+	−	−	+
$\sin(\theta)$	+	+	−	−
$\tan(\theta)$	+	−	+	−

(0,1)
(−1,0)
(1,0)
(0,−1)
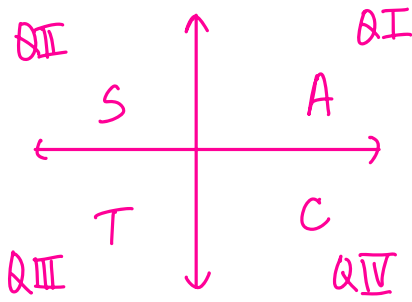
2. Complete the table.

θ in degrees	0°	90°	180°	270°	360°
θ in radians	0	$\pi/2$	π	$\frac{3\pi}{2}$	2π
$\sin\theta$	0	1	0	−1	0
$\cos\theta$	1	0	−1	0	1
$\tan\theta$	0	undefined	0	undefined	0

Two rays that have the same endpoint form an angle. One ray is fixed while the other ray is allowed to move around the endpoint. The endpoint of the rays is called the **vertex** of the angle. The fixed ray is the initial side of the angle, and the rotated ray is the terminal side. *Counterclockwise* rotations produce positive angles and *clockwise* rotations produce negative angles.

225°
initial side
terminal side

initial side
−60°
terminal side
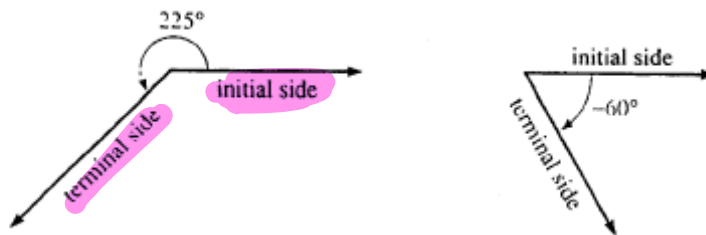
An angle in **standard position** has its vertex at the origin of a coordinate system and the initial side of the angle coincides with the positive *x*- axis. Depending on whether the terminal side falls in Quadrant I, II, III, or IV, we say that the angles lies in the first, second, third or fourth quadrant.

Standard Position

Each Revolution of the angle
Within the Circle is equal to
360 degrees

90°
-270°

y-axis

Quadrant 2   Quadrant 1

180°
-180°

0, 360°
-360°

Positive Angle

Quadrant 3   Quadrant 4

x-axis

Negative Angle

270°
-90°
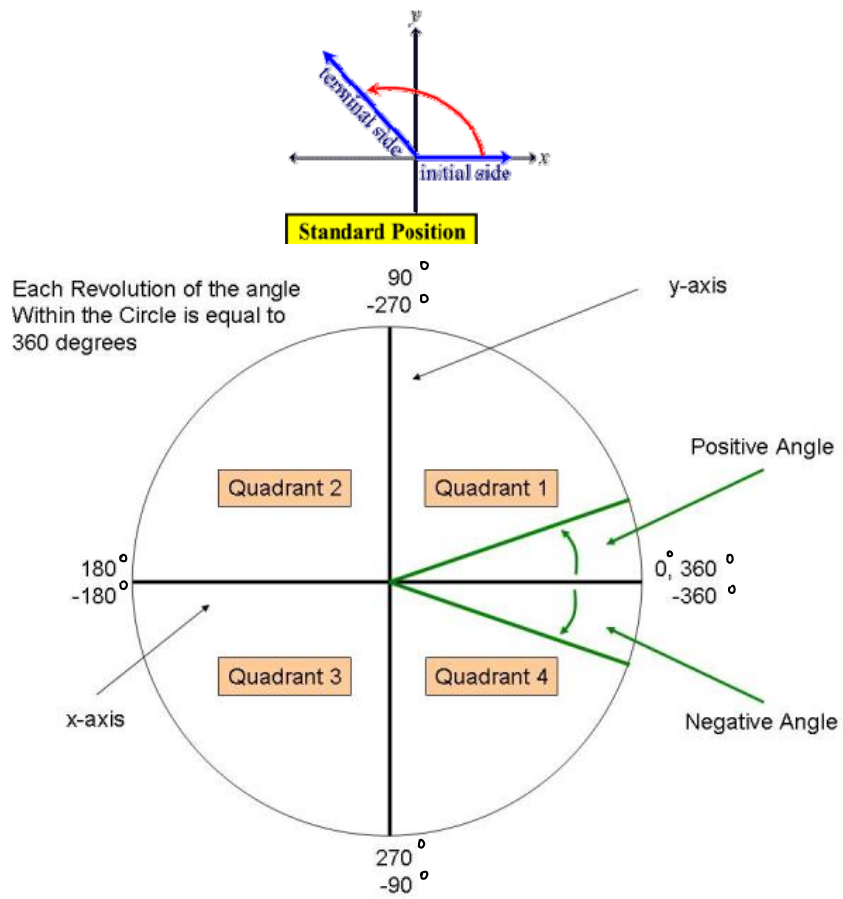
An angle whose terminal side coincides with a coordinate axis is called a *quadrantal angle*.

$\theta = 180°$

Figure 1

$\theta = 270°$
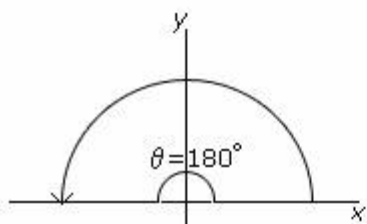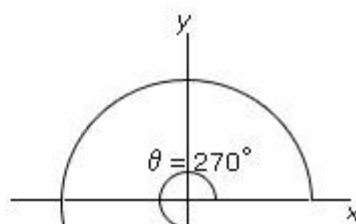
Figure 2

Angles sharing the same initial and terminal sides are called **_coterminal angles_**.

$$120° - (-240°) = 360°$$
$$-240° - 120° = -360°$$
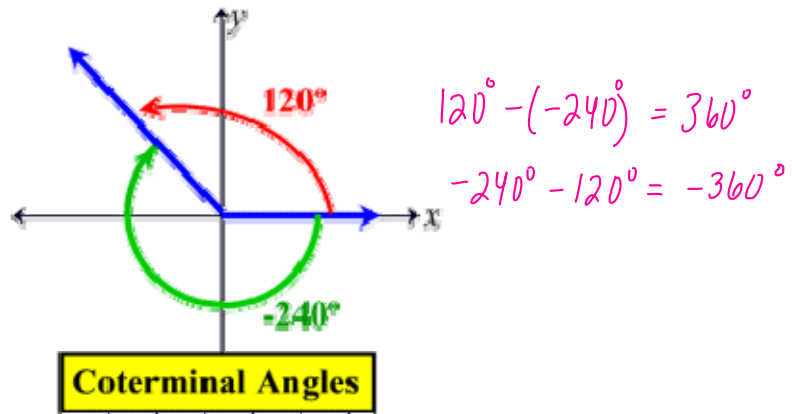
Coterminal Angles

To find coterminal angles: _add_ _multiples of 360°_ .

If two angles are coterminal, their difference is : _a multiple of 360°_ .

Exercise Set A

For 1 – 19, determine in which quadrant the angle of the given measure lies.

1. 215°

2. -110° QIII

3. 318°

4. 72° QI

5. 95°

6. -45° QIV

7. 225°

8. 150° QII

9. 422°

10. -240° QII

11. 680°

12. 23° QI

13. 812°

14. -300° QI

15. 289°

16. $\dfrac{5\pi}{4} \cdot \dfrac{180°}{\pi} = 225°$ QIII

17. $-\dfrac{3\pi}{4}$

18. $\dfrac{5\pi}{3} \cdot \dfrac{180°}{\pi} = 300°$ QIV

19. $\dfrac{7\pi}{6}$

For 20 - 27, name the least possible positive measure and the greatest possible negative measure of an angle that is coterminal with the given angle.

20. 70° +360° → 430° -360° → -290°

21. -60°

22. 110° +360° → 470° -360° → -250°

23. 225°

24. 270° +360° → 630° -360° → -90°

25. -315°

26. -180° +360° → 180° -360° → -540°

27. -930° +360° → -570° +360° → -210° +360° → 150°

For 28- 31, determine whether the following pairs of angles in standard position are coterminal.

28. 40° and 400° ✓ is a mult. of 360°
yes   400° - 40° = 360°
      or   40° - 400° = -360°

29. -120° and 120°

30. 180° and -180°

yes   180° - (-180°) = 360° } mult. of 360°
      or
      -180° - 180° = -360°

31. 90° and -270°

For 32 - 41, sketch an angle in standard position with the given measure

32. 100°
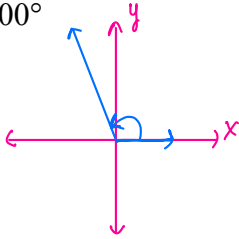
33. 360°

34. 90°
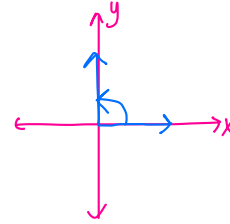
35. -100°

36. -300°
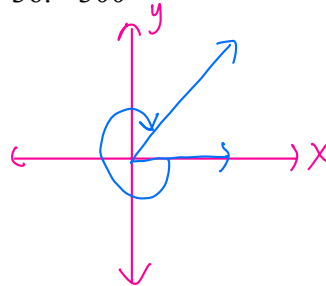
37. 270°

38. -260°
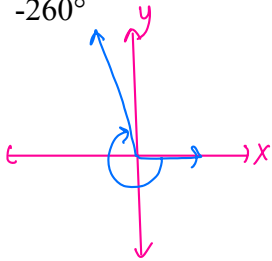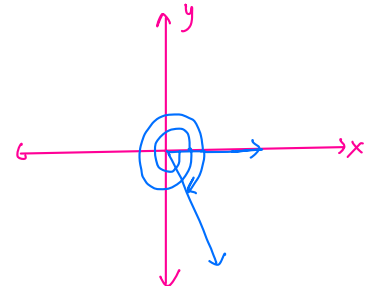
39. -25°

40. -800°

$+360°$
$-440°$
$+360°$
$-80°$ Q IV

41. 1140°

Name_____   **Converting Between Degrees and Radians**

$240° = \dfrac{4\pi}{3}$

$480°$ $\dfrac{8\pi}{3}$

$\dfrac{5\pi}{2}$ $450°$

$\dfrac{\pi}{5}$ $36°$

$10°$ $\dfrac{\pi}{18}$

$\dfrac{4\pi}{9}$ $80°$

$600°$ $\dfrac{10\pi}{3}$

$\dfrac{3\pi}{10}$ $54°$

$50°$ $\dfrac{5\pi}{18}$

$\dfrac{9\pi}{2}$ $810°$

$1080°$ 6π

$\dfrac{\pi}{12}$ $15°$

$432°$ $\dfrac{12\pi}{5}$

$\dfrac{\pi}{18}$	$\dfrac{8\pi}{15}$	$\dfrac{4\pi}{3}$	$15°$	$63°$
$576°$	$\dfrac{11\pi}{2}$	$\dfrac{5\pi}{18}$	$80°$	$\dfrac{18\pi}{5}$
$\dfrac{\pi}{30}$	6π	$\dfrac{15\pi}{4}$	$450°$	$40°$
$54°$	$\dfrac{8\pi}{3}$	$\dfrac{12\pi}{5}$	$153°$	$168°$
8π	$27°$	$36°$	$\dfrac{10\pi}{3}$	$810°$

$\dfrac{16\pi}{5}$ $576°$

$648°$ $\dfrac{12\pi}{5}$

$\dfrac{3\pi}{20}$ $27°$

$96°$ $\dfrac{8\pi}{15}$

$\dfrac{14\pi}{15}$ $168°$

$1440°$ 8π

$\dfrac{2\pi}{9}$ $40°$

$675°$ $\dfrac{15\pi}{4}$

$\dfrac{17\pi}{20}$ $153°$

$6°$ $\dfrac{\pi}{30}$

$\dfrac{7\pi}{20}$ $63°$

$990°$ $\dfrac{11\pi}{2}$