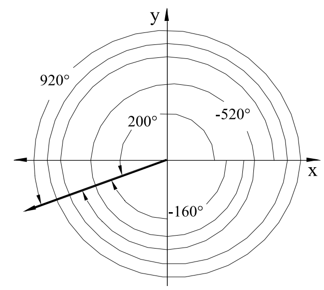
Worksheet 1 **Working with Angles** **Name**

Standard Angle (θ) & Principle Angle

We commonly use θ (theta) to denote an arbitrary missing angle. In particular, we use θ to denote an angle relative to the x+ axis with the counter clockwise orientation as positive and clockwise orientation as negative. This is called the *standard angle*. e.g. $\theta = +90^\circ$ is the same direction as $\theta = -270^\circ$. $\theta = 10^\circ$ is the equivalent direction as $\theta = 370^\circ$. When θ is simplified to its equivalent angle between 0º and 360º ($0^\circ \le \theta < 360^\circ$) we call this the *principle angle*.



Principle vs. Standard Angle

However, there are times when final direction is not the only concern. The dial for a radio tuner or winding a spring are good examples where ± rotation is crucial.

Winding a spring 2¼ turns clockwise could be denoted by $\theta = -810^\circ$. Although this θ as a direction is equivalent to $\theta = 270^\circ$ it should be obvious that using $\theta = -810^\circ$ makes more sense here. Generally speaking, the context should clarify whether or not to simplify θ to its primary angle.

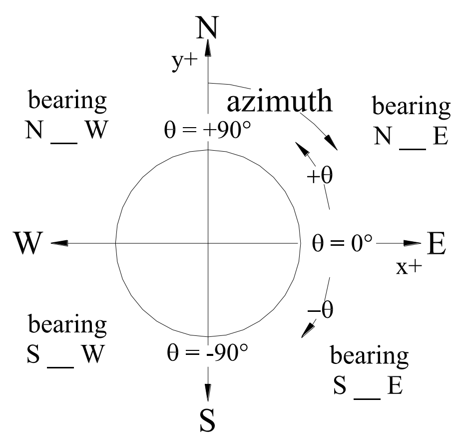
Standard Angles, Azimuth, Bearing and Back Angles

Standard Angle is measured from the positive x-axis (East) with counter-clockwise being positive. The standard angle is usually denoted by θ. In mechanical drawings, engineering diagrams and mathematics standard angle is the most common choice.

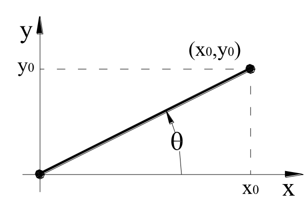
Azimuth (abbreviated *azi*) is a compass heading measured from **due North** with clockwise being positive. e.g. 135º azi = due SE.

Bearing is by compass quadrants. It's measured from **due North** or **due South** whichever is closer. e.g. N 45º E = due NE.

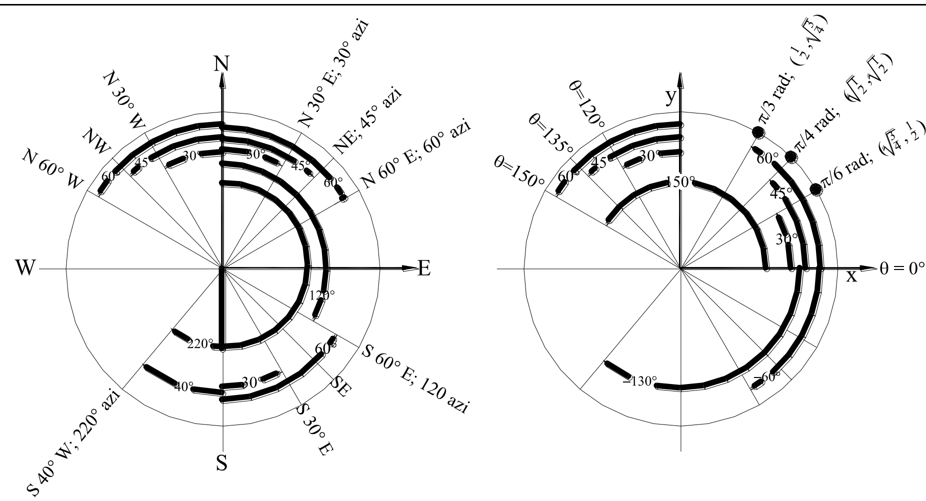
Both azimuth and bearing are common where angle orientation is key.



In a *Cartesian Coordinate System* each (x,y) point may be associated with an angle. Using Cartesian points is convenient when the reference system is primarily horizontal and vertical shifts such as programming in a milling machine layout or architectural drawing.



Example 1



Label the following on the unit circle (r = 1)
Standard Angles in Degrees: 0°, 30°, 45°, 60°, 90°, 135°, 180°, 270°, -30°, 900°, -585°

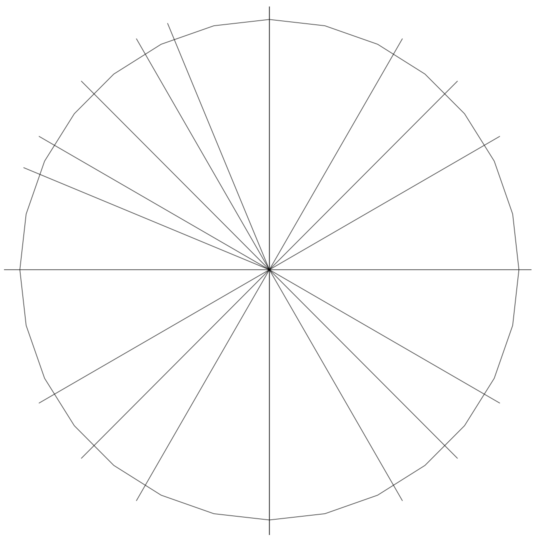
Standard Angles in Radians: 0, π/6, π/3, π/4, π/2, π, -π/4, 15π, -23.25π

Bearings: SW, S 30° W, N 30° W   Azimuths: 150° azi, 210° azi, 300° azi

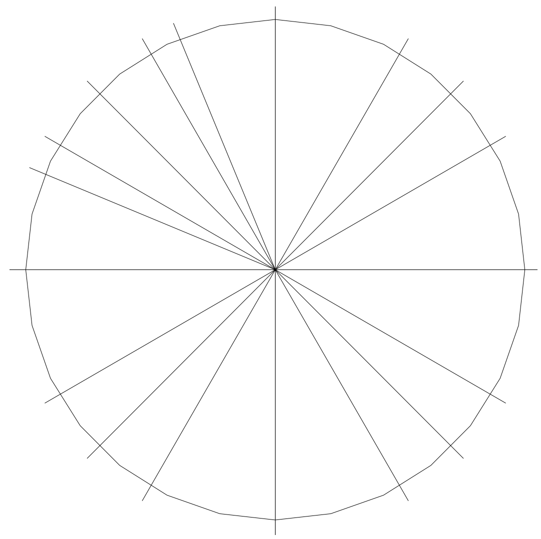
Coordinate Points: (1, 0); $(\sqrt{\tfrac{1}{2}}, -\sqrt{\tfrac{1}{2}})$; $(\tfrac{1}{2}, -\sqrt{\tfrac{3}{4}})$; $(\sqrt{\tfrac{3}{4}}, \tfrac{1}{2})$; (0, -1)

The Critical Angles of the Unit Circle

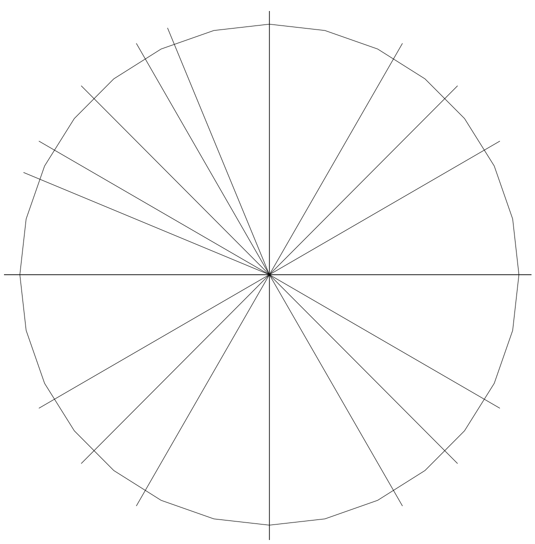
1) **Radians and Degrees**



2) **Azimuths and Bearings**



3) **(x, y) Coordinate Points**



4) **Table of Relationships**

θ°	θ rad	m	(x, y)
0°			
30°			
45°			
60°			
90°			
120°			
135°			
150°			
180°			

5) Convert 100° azi to its equivalent bearing ____________ and positive standard degree angle ________.

6) Convert S 55° E to its equivalent azimuth ____________ and negative standard degree angle _______________.

7) Convert θ = 70° to its equivalent bearing _____________ and negative radian angle ________.

8) Convert -1.4π radians to its equivalent bearing ________________ and positive standard radian angle ________.

9) Find the back angle in positive degrees for 0.2π radians ________________.

10) Find the principle angle (degrees) of 1240° ___________. Find the principle angle (radians) of 37.25π ______________