

Sketch an analog clock face by drawing a large circle and putting tick marks on at the location of each hour.

1. What is the angular separation (in radians) between two adjacent hour marks measured from the center of the clock?

**Solution**

$$\frac{2\pi}{12} = \frac{\pi}{6}$$

2. For each of the hour marks, find the sine and cosine of the angles the hour hand makes. Let the hour hand pointing at 3 o'clock be the positive horizontal axis and pointing at 12 o'clock be the positive vertical axis.

**Solution** Consider the clock face to be the unit circle.

For 12, 3, 6, and 9 o'clock, the sine and cosine are either 0 or  $\pm 1$ .

For the other tick marks, the sine and cosine are either  $\pm \frac{\sqrt{3}}{2}$  or  $\pm \frac{1}{2}$ . Notice that  $\frac{\sqrt{3}}{2} > \frac{1}{2}$ . “Drop” a perpendicular onto either the horizontal or vertical axes. The projection onto the horizontal axis gives the cosine of the angle, as measured counterclockwise from 3 o'clock. The sine of the same angle is the projection onto the vertical axis. The larger projection goes with  $\frac{\sqrt{3}}{2}$ . Notice that this unit circle representation automatically gets the signs correct, even for angles greater than  $\pi$ .

For more help with sines and cosines on the unit circle, see Circle Trigonometry.