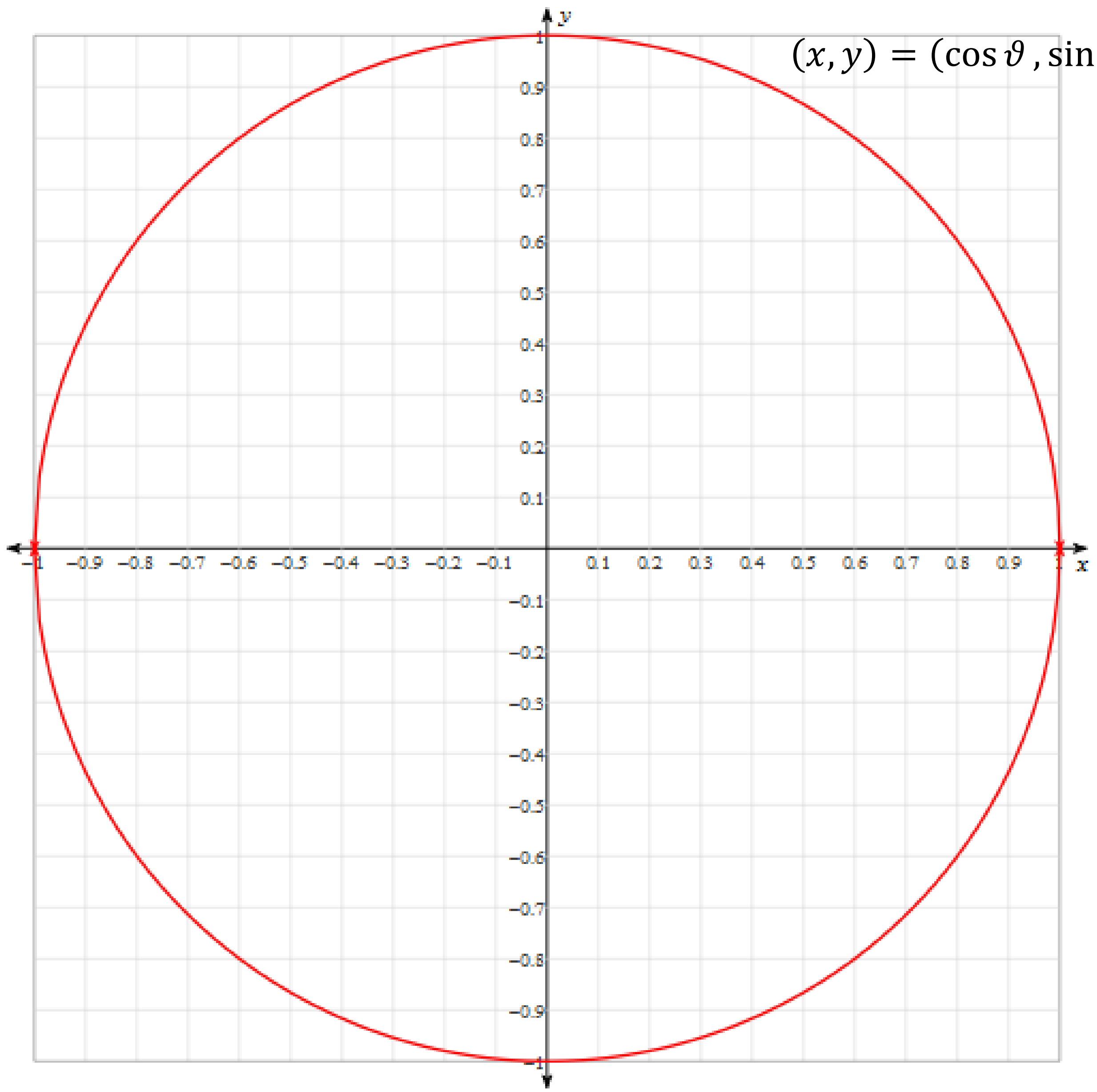
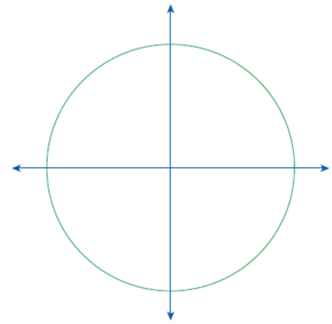
$$(x, y) = (\cos\vartheta, \sin\vartheta)$$

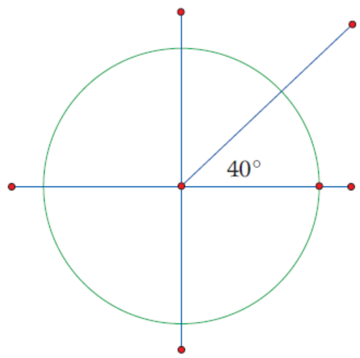


Computing Sines and Cosines by Using the Unit Circle

1. Start with a unit circle drawn on a Cartesian grid.
   A unit circle is a circle with a radius of 1 whose center is the origin.

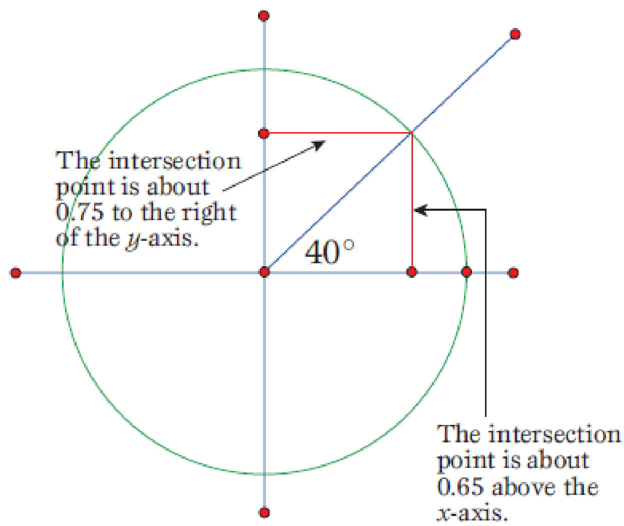


2. Use your protractor to make an angle with respect to the positive part of the x-axis.
   A $40°$ angle is shown here.



3. Locate the point of intersection between the terminal arm of the angle that you have drawn and the unit circle. Using the scale provided, determine the x-value and y-value of this point on the Cartesian plane. **The x-value is the cosine of the angle you have constructed, and the y-value is the sine of the angle. Why?**

   In this case, the cosine of $40°$ is about 0.75 and the sine of $40°$ is about 0.65. Label this point on the diagram.

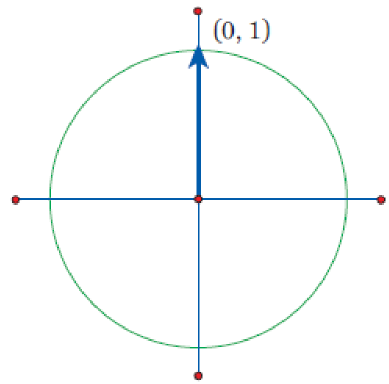


EXERCISES

1. Compute the following sines and cosines by using a protractor, a straight edge, and the unit circle provided. For each angle given, label the point of intersection between the terminal arm of the angle and the unit circle.

   a. $\cos 30° =$________, $\sin 30° =$________
   b. $\cos 170° =$________, $\sin 170° =$________
   c. $\cos 120° =$________, $\sin 120° =$________
   d. $\cos 200° =$________, $\sin 200° =$________
   e. $\cos 80° =$________, $\sin 80° =$________
   f. $\cos 325° =$________, $\sin 325° =$________

2. Using the unit circle, determine the following sines and cosines. The first one is done for you.



a. $\cos 90° = 0$, $\sin 90° = 1$

Explanation: The terminal arm of a $90°$ angle drawn in standard position inside the unit circle will intersect the top of the circle. The coordinates of this point are (0, 1). Therefore, $\cos 90° = 0$ and $\sin 90° = 1$.

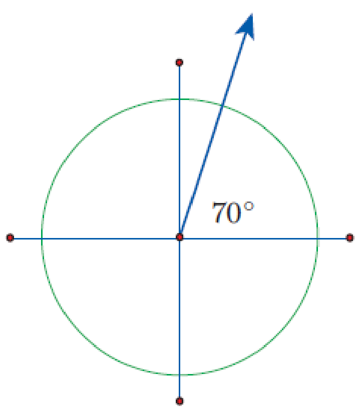
b. $\cos 0° =$________, $\sin 0° =$________

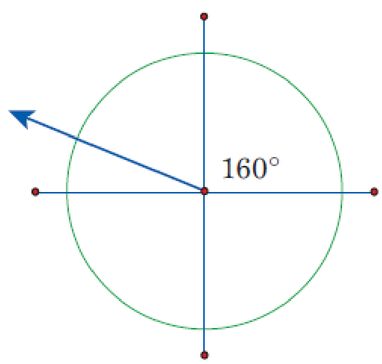
c. $\cos 180° =$________, $\sin 180° =$________

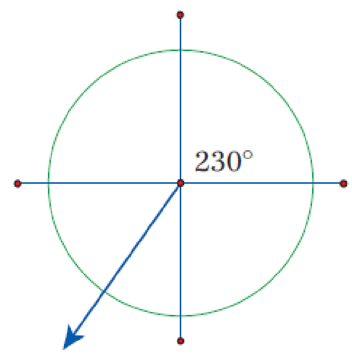
d. $\cos 270° =$________, $\sin 270° =$________

e. $\cos 360° =$________, $\sin 360° =$________

3. Without explicitly computing these values (that is, without using a protractor or a calculator), *approximate*, to the nearest tenth, the sine and cosine of each angle shown in the diagrams below.







$\cos 70° =$_____, $\sin 70° =$_____ $\cos 160° =$_____, $\sin 160° =$_____ $\cos 230° =$_____, $\sin 230° =$_____

4. Without doing the computations, answer the following questions. Justify your answer.

a. Is $\sin 140°$ a positive or a negative number? ______________________________

b. Is $\cos 200°$ a positive number or a negative number? ______________________________

c. Which is bigger: $\sin 23°$ or $\sin 37°$? ______________________________

d. Which is bigger: $\cos 300°$ or $\cos 330°$? ______________________________

5. In which quadrants will $\sin\theta$ be positive? In which quadrants will $\cos\theta$ be positive? Explain.

- $\sin\theta$ will be positive in quadrant(s): ______________________________
- $\cos\theta$ will be positive in quadrant(s): ______________________________

6. Can you find an angle θ such that $\sin\theta = 2$? If so, what angle is it? If you cannot find such an angle, why not?

____

____