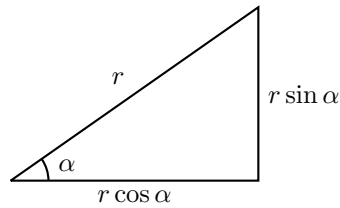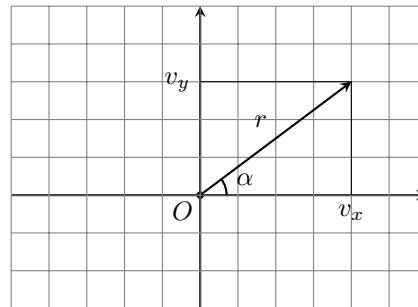# MATH 7: ASSIGNMENT 9

BASIC TRIGONOMETRY

Recall that sine and cosine are defined by the figure below:
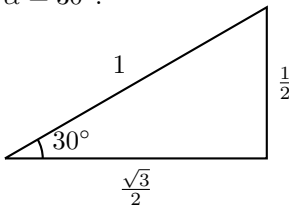

In particular, this shows that if we have a vector $\vec{v}$ that has length r and forms angle α with the x axis, then its x and y components are

$$v_x = r \cos \alpha, \qquad v_y = r \sin \alpha$$

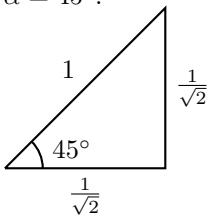## SPECIAL TRIANGLES

$\alpha = 30°$:

$$\sin \alpha = \frac{1}{2}, \cos \alpha = \frac{\sqrt{3}}{2}$$

$\alpha = 45°$:


$$\sin \alpha = \cos \alpha = \frac{1}{\sqrt{2}} = \frac{\sqrt{2}}{2}$$

In this homework, you can use the calculator to compute sin and cos of various angles.

1. Compute the side length of a regular 12-gon inscribed in a circle of radius 1.

2. If a ship travels southeast for 11 miles and then NNE for 5 more miles, where will it end up? I.e., if we draw a coordinate system so that the starting position of the ship is the origin, what will be the coordinates of the new position? What is the distance between the old position and new position?

3. In a △ABC, let $a = BC$, $b = AC$, $c = AB$. Use problem 5 from the previous HW to prove the law of sines:
$$\frac{a}{\sin \angle A} = \frac{b}{\sin \angle B} = \frac{c}{\sin \angle C}$$
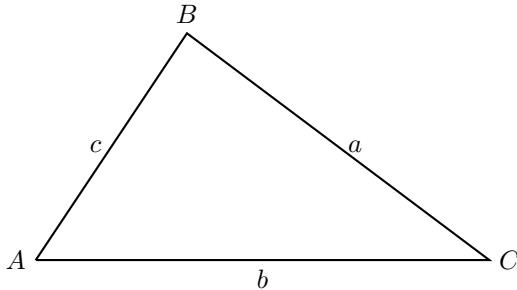
4. In a triangle △ABC, we have $\angle A = 40°$, $\angle B = 60°$ and $AB = 2$ cm. Can you find the remaining angle and side lengths? (Hint: use law of sines)

5. The stepladder shown below has height of 8 feet. The angle between two legs at the top is $30°$. How long is each leg?

6. (a) If $\sin \alpha = 0.8$, what is $\cos \alpha$?
   (b) Prove that $\sin^2 \alpha + \cos^2 \alpha = 1$

*7. A 10-kg weight is suspended on the rope as shown below. The two ropes form $10°$ angle with the horizontal. What is tension of the ropes (measured in kg)? Will the rope break (it can safely hold 70 kg)? What if we tried to make the angle $1°$? [Hint: since the weight is not moving, the sum of forces must be zero...]