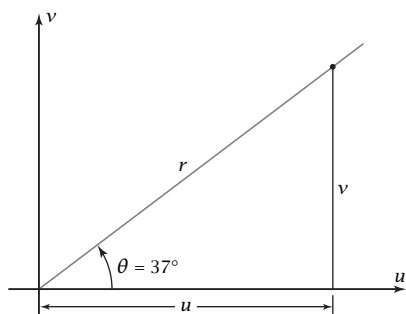


**Exploration 2-3a: Definitions of Sine and Cosine**

Date: \_\_\_\_\_

**Objective:** Learn the formal definitions of sine and cosine functions.

1. The figure shows an angle of  $\theta = 37^\circ$  in standard position in a  $uv$ -coordinate system. Measure the angle with a protractor. Do you agree that it is  $37^\circ$ ? \_\_\_\_\_



2. The figure shows a point on the terminal side of  $\theta$ . The  $u$ - and  $v$ -coordinates of the point form a right triangle whose hypotenuse is the distance from the origin to the point. Measure the three distances, to the nearest 0.1 cm.

Adjacent leg,  $u =$  \_\_\_\_\_Opposite leg,  $v =$  \_\_\_\_\_Hypotenuse,  $r =$  \_\_\_\_\_

3. You recall from previous courses that the **sine** and **cosine** of an angle in a right triangle are defined

$$\sin \theta = \frac{\text{opposite leg}}{\text{hypotenuse}} \quad \cos \theta = \frac{\text{adjacent leg}}{\text{hypotenuse}}$$

Use the answers in Problem 3 to calculate

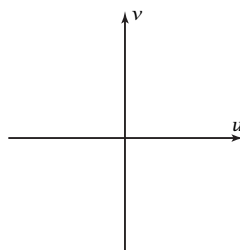
$$\sin 37^\circ \approx \text{_____} \quad \cos 37^\circ \approx \text{_____}$$

4. With your calculator in degree mode, find values of  $\sin 37^\circ$  and  $\cos 37^\circ$ . Do your approximate values in Problem 3 agree with these precise values?

$$\sin 37^\circ = \text{_____}$$

$$\cos 37^\circ = \text{_____}$$

5. The definitions of sine and cosine can be extended to angles that measure rotation with the aid of the **reference angle**. Sketch an angle of  $\theta = 125^\circ$ . Then mark and calculate the reference angle,  $\theta_{\text{ref}}$ .



6. Use your calculator to find

$$\sin \theta_{\text{ref}} = \text{_____} \quad \cos \theta_{\text{ref}} = \text{_____}$$

7. The formal definitions of sine and cosine are

$$\sin \theta = \frac{\text{vertical coordinate}}{\text{radius}}$$

$$\cos \theta = \frac{\text{horizontal coordinate}}{\text{radius}}$$

Calculate  $\sin 125^\circ$  and  $\cos 125^\circ$ . How are these numbers related to the sine and cosine of the reference angle in Problem 6? How do you explain that  $\cos 125^\circ$  is negative?

8. State what sign the sine and cosine will have for angles that terminate in

Quadrant I: sine \_\_\_\_\_ cosine \_\_\_\_\_

Quadrant II: sine \_\_\_\_\_ cosine \_\_\_\_\_

Quadrant III: sine \_\_\_\_\_ cosine \_\_\_\_\_

Quadrant IV: sine \_\_\_\_\_ cosine \_\_\_\_\_

9. What did you learn as a result of doing this Exploration that you did not know before?