# Trigonometric Patterns
**ID: 12434**

**Time required**
*15 minutes*

## Activity Overview
*Students will use the unit circle to examine patterns in the six trigonometric functions.*

## Topic: Trigonometry
- *Unit Circle*
- *Right Triangle Trigonometry*

## Teacher Preparation and Notes
- *The angle measures will vary from the exact values in the answer tables due to Cabri Jr. only being able to measure coordinates to one decimal place. Make students aware that they may need to use the closest angle measure possible for some values.*

- *The questions in the document are starting points for discussions about the patterns in the values of trig functions. Teachers should be prepared to discuss patterns beyond the ones in the document.*

- *The Cabri Jr. file "UNITC" must be loaded on all calculators before the start of the activity.*

- ***To download the Cabri Jr. file and the student worksheet, go to education.ti.com/exchange and enter "12434" in the keyword search box.***

## Associated Materials
- *TrigPatterns_Student.doc*
- *UNITC.8xv*

## Suggested Related Activities
*To download any activity listed, go to education.ti.com/exchange and enter the number in the keyword search box.*

- *Graphs of Sine, Cosine, and Tangent (TI-Nspire technology) — 8314*

- *Graphs of Tangent, Cotangent, Secant, and Cosecant (TI-Nspire technology) — 9432*

- *Trigonometric Ratios (TI-84 Plus family) — 9534*

**Searching for Patterns**

Students will move the triangle on the unit circle to find the angle measures listed in the table on the student worksheet. Students will record the values and then answer questions about patterns in the results. Because the *Cabri Jr.* file only measures the angle less than 90°, there is opportunity for some further student learning. This means that when the angle being displayed is 30° and the point is in the second quadrant, the angle being observed is really 150° (180° − 30°).

Students can write the ratios on their worksheet and then use the Home screen to do their calculations.

Note that due to rounding in *Cabri Jr.*, the answers are approximate, not exact.

*Discussion Questions*

- *What happens at 90°, 180°, 270°, and 360°?*

- *Why is the tangent function undefined for some angle measures?*

**Extension – Patterns in reciprocal functions**

In this problem, students will repeat the activity for the co-trigonometric functions. Students should notice that these functions are the reciprocals of the functions from the first part of the activity by looking at the given formulas. This will help them in calculating these functions because they can use simply find the reciprocals on the Home screen instead of finding new ratios.

*Discussion Questions*

- *Are any of the functions undefined? For what values?*

- *Do any of the patterns match the patterns from the functions in the activity?*
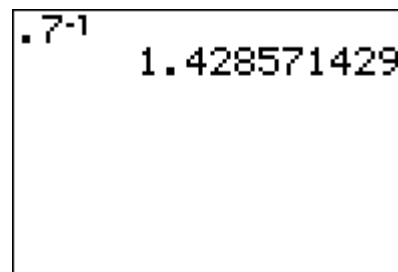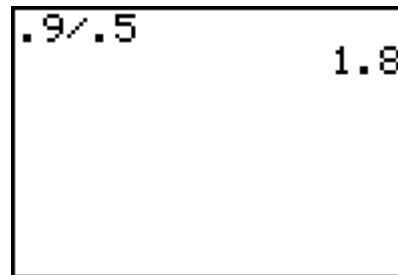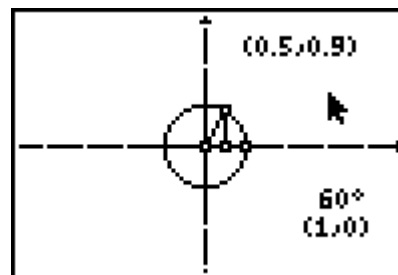
**Student Solutions**

| $\theta$ | sin $\theta$ | cos $\theta$ | tan $\theta$ |
|---|---|---|---|
| 30° | 0.5 | 0.866 | 0.577 |
| 45° | 0.707 | 0.707 | 1 |
| 60° | 0.866 | 0.5 | 1.732 |
| 90° | 1 | 0 | undefined |
| 120° | 0.866 | −0.5 | −1.732 |
| 135° | 0.707 | −0.707 | −1 |
| 150° | 0.5 | −0.866 | −0.577 |
| 180° | 0 | −1 | 0 |
| 210° | −0.5 | −0.866 | 0.577 |
| 225° | −0.707 | −0.707 | 1 |
| 240° | −0.866 | −0.5 | 1.732 |
| 270° | −1 | 0 | undefined |
| 300° | −0.866 | 0.5 | −1.732 |
| 315° | −0.707 | 0.707 | −1 |
| 330° | −0.5 | 0.866 | −0.577 |
| 360° | 0 | 1 | 0 |

1. $0° < \theta < 180°$

2. $180° < \theta < 270°$

3. Positive $0° < \theta < 90°$, $180° < \theta < 270°$ because sine and cosine have same sign
   Negative $90° < \theta < 180°$, $270° < \theta < 360°$ because sine and cosine have different signs

4. cos(330°)

5. Possible response: cos(45°) = cos(315°); cos(60°) = cos(300°)

6. tan(225°)

7. Possible response: tan(60°) = tan(240°), tan(30°) = tan(210°)

8. Answers will vary. Sample response: The values in the first quadrant are repeated in the other quadrants, but have different signs.

9. Answers will vary. Sample response: The values of sine and cosine switch within a quadrant, such as sin(30°) = cos(60°), but the signs may be opposite in some quadrants.

**Extension**

| $\theta$ | **sin $\theta$** | **cos $\theta$** | **tan $\theta$** |
|---|---|---|---|
| 30° | 1.155 | 2 | 1.732 |
| 45° | 1.414 | 1.414 | 1 |
| 60° | 2 | 1.155 | 0.577 |
| 90° | undefined | 1 | 0 |
| 120° | −2 | 1.155 | −1.732 |
| 135° | −1.414 | 1.414 | −1 |
| 150° | −1.155 | 2 | −1.732 |
| 180° | −1 | undefined | undefined |
| 210° | −1.155 | −2 | 1.732 |
| 225° | −1.414 | −1.414 | 1 |
| 240° | −2 | −1.155 | 0.577 |
| 270° | undefined | -1 | 0 |
| 300° | 2 | −1.155 | −0.577 |
| 315° | 1.414 | −1.414 | −1 |
| 330° | 1.144 | −2 | −1.732 |
| 360° | 1 | undefined | undefined |