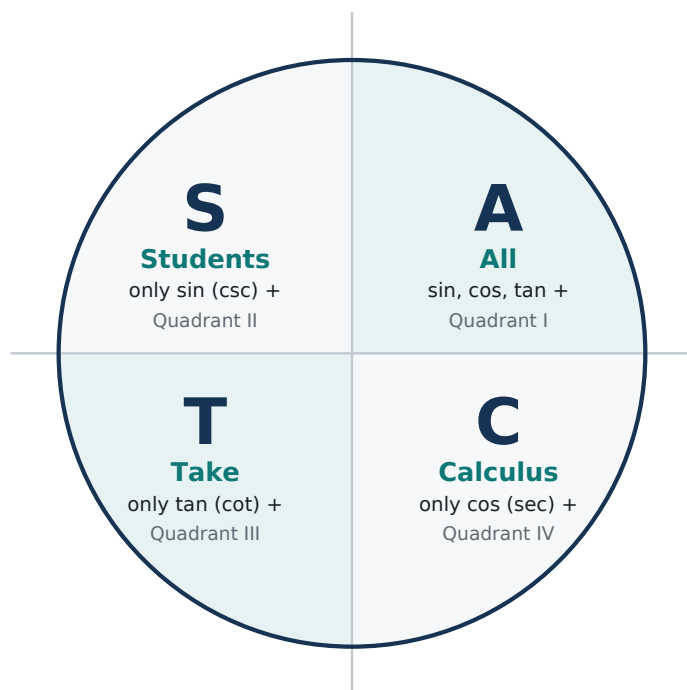


ASTC — All Students Take Calculus

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Which trig functions are positive in each quadrant of the unit circle



Pick the phrase you remember

All **S**tudents **T**ake **C**alculus

All **S**ilver **T**ea **C**ups

Add **S**ugar **T**o **C**offee

All **S**mart **T**rig **C**lasses

Start in Quadrant I and go anticlockwise:
A, S, T, C. The letter names what is positive.

Reciprocals share a sign: csc goes with sin,
sec goes with cos, cot goes with tan.

Signs of all six functions

	Quadrant I 0°–90°	Quadrant II 90°–180°	Quadrant III 180°–270°	Quadrant IV 270°–360°
sin θ	+	+	–	–
cos θ	+	–	–	+
tan θ	+	–	+	–
csc θ	+	+	–	–
sec θ	+	–	–	+
cot θ	+	–	+	–

QUICK CHECK

Is each value positive or negative? Write + or –. No need to calculate it.

1 $\sin 200^\circ =$ _____

4 $\sin 7\pi/6 =$ _____

2 $\cos 300^\circ =$ _____

5 $\cos 2\pi/3 =$ _____

3 $\tan 100^\circ =$ _____

6 $\tan 5\pi/3 =$ _____

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ASTC Notes and Answers

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Reference angles, one worked example, and the quick-check answers

REFERENCE ANGLES

The acute angle θ' between the terminal side and the x-axis. Use it to find the size of the value.

	Quadrant I	Quadrant II	Quadrant III	Quadrant IV
Degrees	$\theta' = \theta$	$\theta' = 180^\circ - \theta$	$\theta' = \theta - 180^\circ$	$\theta' = 360^\circ - \theta$
Radians	$\theta' = \theta$	$\theta' = \pi - \theta$	$\theta' = \theta - \pi$	$\theta' = 2\pi - \theta$

WORKED EXAMPLE 1

Find $\sin 150^\circ$.

1. 150° is between 90° and 180° , so it is in Quadrant II.
2. Reference angle: $\theta' = 180^\circ - 150^\circ = 30^\circ$.
3. $\sin 30^\circ = 1/2$.
4. In Quadrant II, sin is positive (the S in ASTC).
5. So $\sin 150^\circ = +1/2$. Check on the chart: the y-coordinate at 150° is $1/2$.

WORKED EXAMPLE 2

Find $\cos 240^\circ$.

1. 240° is between 180° and 270° , so it is in Quadrant III.
2. Reference angle: $\theta' = 240^\circ - 180^\circ = 60^\circ$.
3. $\cos 60^\circ = 1/2$.
4. In Quadrant III only tan is positive, so cos is negative.
5. So $\cos 240^\circ = -1/2$. Check on the chart: the x-coordinate at 240° is $-1/2$.

QUICK-CHECK ANSWERS

- | | |
|---|--|
| 1. $\sin 200^\circ$: Quadrant III $\rightarrow -$ (negative) | 4. $\sin 7\pi/6$: Quadrant III $\rightarrow -$ (negative) |
| 2. $\cos 300^\circ$: Quadrant IV $\rightarrow +$ (positive) | 5. $\cos 2\pi/3$: Quadrant II $\rightarrow -$ (negative) |
| 3. $\tan 100^\circ$: Quadrant II $\rightarrow -$ (negative) | 6. $\tan 5\pi/3$: Quadrant IV $\rightarrow -$ (negative) |

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