# Geometry · Unit 4 · Assessment Guide

*Right Triangle Trigonometry*

*For the Parent or Teacher — What to look for*

*Unit 4 introduces sine, cosine, and tangent — purely for RIGHT triangles. Common errors: applying trig to non-right triangles, mixing up opposite/adjacent, treating sin as linear. Look for whether students think structurally or rely on plug-and-chug.*

## Problem 1 — Labeling sides

- With respect to angle B: side BC is now ADJACENT, side AC is OPPOSITE, AB is still the HYPOTENUSE.
- The hypotenuse stays the same — it's always across from the right angle. Opposite and adjacent SWITCH between the two acute angles.
- Common misconception: students think 'opposite leg' is fixed for a triangle (it isn't — it depends on which acute angle you're considering).

## Problem 2 — Ratio definitions

- sin theta = opposite/hypotenuse.  cos theta = adjacent/hypotenuse.  tan theta = opposite/adjacent.
- Mnemonic: SOH-CAH-TOA.
- Watch that students write the ratios correctly, not just the mnemonic. A student who writes 'SOH-CAH-TOA' as the answer but can't tell you which side goes where has memorized without understanding.

## Problem 3 — Find missing side with cos

- Cos relates angle to adjacent and hypotenuse: cos 38 = adj/15.
- adj = 15 · cos 38 ≈ 15 · 0.788 ≈ 11.8 units.
- Watch students who set up sin or tan by mistake. The signal of understanding is articulating WHY cos: 'because I have the hypotenuse and want the adjacent.'

## Problem 4 — 7-24-25 triangle and arctan

- Hypotenuse: sqrt(49+576) = sqrt(625) = 25.
- Angle opposite 7: arctan(7/24) ≈ 16.3 degrees. (Could also use arcsin(7/25).)
- Other acute angle: 90 - 16.3 = 73.7 degrees (or arctan(24/7)).
- Acute angles in a right triangle sum to 90 degrees because the THREE angles sum to 180 and one is 90. Strong students mention this explicitly.

## Problem 5 — Sine/cosine complement

- cos 60 = 1/2 = sin 30.
- Strong explanation: in a right triangle with acute angles 30 and 60, the leg opposite 30 is the leg adjacent to 60. So sin 30 (opposite/hyp) = cos 60 (adjacent/hyp).
- This is the 'sine of an angle = cosine of its complement' identity, prepping for Algebra 2 trig functions.
- Weak: just states 'they're the same because of the formula' with no geometric reasoning.

## Problem 6 — Lighthouse angle of depression

- Diagram: vertical lighthouse 60 ft, boat at horizontal distance d. Angle of depression 22 degrees = angle between horizontal and line of sight.
- tan 22 = 60/d, so d = 60/tan 22 ≈ 60/0.404 ≈ 148.5 ft.

- The diagnostic is the diagram: does the student correctly place the 22 degree angle? Angle of depression is measured from the HORIZONTAL down, but by alternate interior angles it equals the angle of elevation at the boat.
- Watch for students who get tan 22 = d/60 (wrong: opposite/adjacent reversed).

### Problem 7 — Wheelchair ramp

- tan 4.8 = 30/horizontal, horizontal = 30/tan 4.8 ≈ 30/0.084 ≈ 357 inches ≈ 29.8 ft.
- The diagnostic: do students distinguish 'horizontal length' from 'ramp length' (the hypotenuse)? The problem says 'horizontal length' — use tangent, not sine.
- A student who uses sine gets the ramp length itself — close, but technically wrong question.

### Problem 8 — Diego's hidden assumption

- Diego is using sin 60 = AC / 8, which requires AB = 8 to be the HYPOTENUSE. But the problem says nothing about a RIGHT triangle.
- If triangle ABC is not a right triangle, sin 60 has no straight 'opposite over hypotenuse' meaning — you'd need the Law of Sines (Algebra 2 content).
- The unit teaches RIGHT triangle trig exclusively. Diego has assumed something not given. The problem as stated is NOT solvable with Unit 4 tools.
- Strong students articulate this; weak students just copy Diego's work.

### Problem 9 — Lin's linearity error

- sin 30 = 0.5, sin 60 ≈ 0.866. 2·0.5 = 1.0, which is NOT ≈ 0.866. So Lin is wrong.
- Underlying misconception: students treating trig functions as if they were linear (like f(x) = mx). Trig functions are nonlinear; doubling the angle does NOT double the sine.
- Strong: students mention that sine maxes out at 1.

### Problem 10 — Pythagorean identity

- sin squared theta + cos squared theta = (opp/hyp) squared + (adj/hyp) squared = (opp squared + adj squared)/(hyp squared) = (hyp squared)/(hyp squared) = 1.
- The Pythagorean Theorem appears in the step opp squared + adj squared = hyp squared.
- Strong students see this as a unification: the most famous identity in trig is just the Pythagorean Theorem in disguise.

### Problem 11 — Ladder modeling

- If angle is 60 degrees from horizontal, base distance d = 12·cos 60 = 6 ft. At 90 (straight up), d = 0. At 0 (lying flat), d = 12.
- Larger angle means smaller base distance. So minimum angle 60 degrees means MAXIMUM base distance = 6 ft.
- What about minimum? No upper constraint stated, so minimum base = 0 (ladder vertical).
- Many students confuse 'minimum angle' with 'minimum distance' — they are INVERSELY related when the ladder length is fixed.
- Strong students sanity-check: closer to wall = more vertical = larger angle.

*— end —*