GENERAL

law of sines and cosines review worksheet

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Mastering Trigonometry: A Comprehensive Review of the Law of Sines and Cosines Worksheet

Whether you're a high school student tackling geometry, a college freshman diving into trigonometry, or a lifelong learner brushing up on math fundamentals, the **law of sines and cosines review worksheet** is an invaluable tool. It consolidates the core concepts, provides practice problems, and guides you through the reasoning behind each step. In this article, we'll explore the theory behind these two pivotal trigonometric laws, demonstrate how to solve a variety of problems, and offer practical tips to turn every worksheet into a learning opportunity.

What Is the Law of Sines?

When you're given two angles and a side (the *ASA* or *AAS* case), or two sides and a non‑included angle (the *SSA* case), the law of sines gives you a reliable way to find the missing side or angle. It states that the ratio of the length of a side of a triangle to the sine of its opposite angle is constant for all three sides:

Here, \\(a\\), \\(b\\), and \\(c\\) are the side lengths, while \\(A\\), \\(B\\), and \\(C\\) are the angles opposite those sides.

When to Use It

- ASA or AAS – Two angles and one side known.
- SSA – Two sides and a non‑included angle known.
- When you need to find a side or angle in any non‑right triangle.

Practical Example

Suppose you know that in triangle \\(ABC\\), side \\(a = 8\\) cm, angle \\(A = 30^\\circ\\), and angle \\(B = 45^\\circ\\). To find side \\(b\\), apply the law of sines:

Since \\(\\sin 30^\\circ = 0.5\\) and \\(\\sin 45^\\circ \\approx 0.7071\\), you get:

Thus, \\(b \\approx 16 \\times 0.7071 \\approx 11.31\\) cm.

What Is the Law of Cosines?

When you're given two sides and the included angle (the *SAS* case) or all three sides (the *SSS* case), the law of cosines provides a direct way to find the missing side or angle. It generalizes the Pythagorean theorem to any triangle:

Again, \\(a\\), \\(b\\), and \\(c\\) are side lengths, and \\(C\\) is the angle opposite side \\(c\\). The formula can be rearranged to solve for any side or angle.

When to Use It

- SAS – Two sides and the included angle known.
- SSS – All three sides known.
- When the law of sines leads to an ambiguous SSA case.

Practical Example

Given triangle \\(ABC\\) with sides \\(a = 7\\) cm, \\(b = 9\\) cm, and angle \\(C = 120^\\circ\\), find side \\(c\\):

Since \\(\\cos 120^\\circ = -0.5\\), the calculation becomes:

Thus, \\(c \\approx \\sqrt{193} \\approx 13.89\\) cm.

Why a Review Worksheet Is Essential

A **law of sines and cosines review worksheet** does more than just list problems. It:

1. Reinforces Theory – Each problem is paired with a brief reminder of the underlying principle.
2. Builds Confidence – Step by step solutions help you see the logic behind each move.
3. Encourages Active Learning – By solving problems yourself before checking the answer, you engage deeper with the material.
4. Identifies Weaknesses – Frequent error patterns surface, allowing you to focus your study sessions.

Types of Questions on a Review Worksheet

- Basic Applications – Direct use of the law to find a missing side or angle.
- Ambiguous Cases – SSA problems where two solutions are possible.
- Mixed Problems – Combining both laws in a single problem set.
- Real World Contexts – Trigonometry in navigation, engineering, and physics.
- Proofs and Derivations – Demonstrating the relationship between the two laws.

Sample Problem Set

Problem 1 – Simple ASA

In triangle \\(XYZ\\), \\(X = 40^\\circ\\), \\(Y = 60^\\circ\\), and \\(x = 10\\) cm. Find side \\(y\\).

Problem 2 – SSA Ambiguity

Triangle \\(ABC\\) has side \\(a = 5\\) cm, side \\(b = 7\\) cm, and angle \\(A = 30^\\circ\\). Determine all possible values of side \\(c\\).

Problem 3 – SAS Using Cosines

Given triangle \\(DEF\\) with sides \\(d = 8\\) cm, \\(e = 6\\) cm, and included angle \\(D = 45^\\circ\\). Find side \\(f\\).

Problem 4 – SSS to Find an Angle

Triangle \\(LMN\\) has sides \\(l = 5\\) cm, \\(m = 12\\) cm, and \\(n = 13\\) cm. Find angle \\(N\\).

Problem 5 – Real World Application

A surveyor measures a building’s height by casting a shadow. The angle of elevation to the top is \\(35^\\circ\\) and the shadow length is \\(20\\) m. Using the law of sines, find the building’s height.

Step by Step Solutions

Solution to Problem 1

Since we have ASA, we can use the law of sines. First, find the third angle:

Now apply the law of sines:

With \\(\\sin 40^\\circ \\approx 0.6428\\) and \\(\\sin 60^\\circ \\approx 0.8660\\):

Solution to Problem 2

Use the law of sines to solve for \\(c\\). First, compute \\(\\sin B\\) via the law of sines:

Since \\(\\sin 30^\\circ = 0.5\\), we get:

Now, \\(B\\) could be \\(\\arcsin 0.7 \\approx 44.4^\\circ\\) or \\(180^\\circ - 44.4^\\circ = 135.6^\\circ\\). Compute each case for side \\(c\\) using the law of sines again:

Since \\(C = 180^\\circ - A - B\\), we have two scenarios:

1. Case 1: B = 44.4^\\circ – Then \\(C = 180^\\circ - 30^\\circ - 44.4^\\circ = 105.6^\\circ\\). Thus:
   \\[
   c = \\frac{a \\sin C}{\\sin A} = \\frac{5 \\sin 105.6^\\circ}{\\sin 30^\\circ} \\approx \\frac{5 \\times 0.9665}{0.5} \ \approx 9.67 \\text{ cm}
   \\]
2. Case 2: B = 135.6^\\circ – Then \\(C = 180^\\circ - 30^\\circ - 135.6^\\circ = 14.4^\\circ\\). Thus:
   \\[
   c \\approx \\frac{5 \\sin 14.4^\\circ}{0.5} \\approx \\frac{5 \\times 0.2490}{0.5} \\approx 2.49 \\text{ cm}
   \\]

Therefore, side \\(c\\) can be either approximately \\(9.67\\) cm or \\(2.49\\) cm, illustrating the SSA ambiguity.

Solution to Problem 3

We’re given SAS, so the law of cosines is ideal:

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