

Word Problems Involving the Law of Sines

Trigonometry Worksheet · Grade 10–12

Name: _____

Date: _____

Learning Objectives

- Apply the Law of Sines to find missing sides and angles in oblique triangles
- Set up and solve proportional equations using corresponding angle-side pairs
- Translate real-world word problems into oblique triangle diagrams and solve using the Law of Sines

Problems

1. In triangle ABC, angle A = 40° and side a = 25 cm. If angle B = 70°, find side b using the Law of Sines.

$$\frac{a}{\sin A} = \frac{b}{\sin B}$$

2. In triangle ABC, angle A = 32° and side a = 42.9 cm. If angle B = 81.8°, find side b.

$$\frac{42.9}{\sin 32^\circ} = \frac{b}{\sin 81.8^\circ}$$

3. A surveyor finds that angle C = 112.90°, angle A = 31.10°, and side b = 347.6 feet across a river. Find side a (the distance across the river).

$$\frac{a}{\sin A} = \frac{b}{\sin B}$$

4. Two forest rangers at stations A and B, which are 5.0 miles apart, spot a fire at point C. Ranger A measures angle A = 52° and ranger B measures angle B = 61°. How far is the fire from station A?

$$\frac{b}{\sin B} = \frac{c}{\sin C}$$

5. A telephone pole leans away from the sun at an angle of 7° from vertical. The pole casts a shadow 30 feet long on flat ground when the sun's elevation angle is 54°. Find the length of the pole.

$$\frac{p}{\sin 54^\circ} = \frac{30}{\sin(180^\circ - 54^\circ - 83^\circ)}$$

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6. In an oblique triangle, side $c = 18.5$ m, angle $A = 43^\circ$, and angle $C = 98^\circ$. Find side a .

$$\frac{a}{\sin 43^\circ} = \frac{18.5}{\sin 98^\circ}$$

7. Two ships leave port at the same time. The angle between their paths is 65° . After some time, ship A has traveled 120 km and ship B has traveled 150 km. A coast guard vessel at ship A measures the angle between ship B and the port as 72° . Find the distance between the two ships.

$$\frac{d}{\sin 65^\circ} = \frac{120}{\sin(180^\circ - 65^\circ - 72^\circ)}$$

8. Find the unknown angle B in an oblique triangle where side $a = 22$ ft, side $b = 31$ ft, and angle $A = 38^\circ$.

$$\frac{\sin B}{b} = \frac{\sin A}{a}$$

9. A triangular plot of land has a boundary side of 640 meters. The angles at the two ends of this side are 78° and 55° . Find the longest side of the triangular plot.

$$\frac{s}{\sin(180^\circ - 78^\circ - 55^\circ)} = \frac{640}{\sin 55^\circ}$$

10. From a point P on one bank of a river, a surveyor measures the angle to a tree at point T on the opposite bank as 63° . She then walks 200 meters along the bank to point Q and measures the angle $QPT = 48^\circ$ and angle $PQT = 69^\circ$. Find the distance PT across the river.

$$\frac{PT}{\sin(\angle PQT)} = \frac{PQ}{\sin(\angle PTQ)}$$

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Word Problems Involving the Law of Sines — Answer Key

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Answer Key

1. Answer: $b \approx 36.3$ cm

- Write the Law of Sines proportion: $a/\sin A = b/\sin B$
 - Substitute known values: $25/\sin 40^\circ = b/\sin 70^\circ$
 - Cross multiply: $b = 25 \cdot \sin 70^\circ / \sin 40^\circ$
 - Calculate: $b = 25 \cdot 0.9397 / 0.6428 \approx 36.3$ cm
-

2. Answer: $b \approx 80.1$ cm

- Set up the Law of Sines: $42.9/\sin 32^\circ = b/\sin 81.8^\circ$
 - Cross multiply: $b = 42.9 \cdot \sin 81.8^\circ / \sin 32^\circ$
 - Evaluate: $b = 42.9 \cdot 0.9900 / 0.5299$
 - Calculate: $b \approx 80.1$ cm
-

3. Answer: $a \approx 173.9$ ft

- Find angle B: $B = 180^\circ - 112.90^\circ - 31.10^\circ = 36^\circ$
 - Set up Law of Sines: $a/\sin 31.10^\circ = 347.6/\sin 36^\circ$
 - Cross multiply: $a = 347.6 \cdot \sin 31.10^\circ / \sin 36^\circ$
 - Calculate: $a = 347.6 \cdot 0.5165 / 0.5878 \approx 173.9$ ft
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4. Answer: $b \approx 4.7$ miles

- Find angle C: $C = 180^\circ - 52^\circ - 61^\circ = 67^\circ$
 - Side c (opposite angle C) = 5.0 miles (distance between stations)
 - Set up: $b/\sin 61^\circ = 5.0/\sin 67^\circ$
 - Calculate: $b = 5.0 \cdot \sin 61^\circ / \sin 67^\circ \approx 5.0 \cdot 0.8746 / 0.9205 \approx 4.7$ miles
-

5. Answer: $p \approx 38.1$ ft

- The angle at the tip of the shadow = $180^\circ - 54^\circ - 83^\circ = 43^\circ$
 - The pole makes an angle of $90^\circ - 7^\circ = 83^\circ$ with the ground
 - Apply Law of Sines: $p/\sin 54^\circ = 30/\sin 43^\circ$
 - Calculate: $p = 30 \cdot \sin 54^\circ / \sin 43^\circ \approx 30 \cdot 0.8090 / 0.6820 \approx 38.1$ ft
-

6. Answer: $a \approx 12.7$ m

- Set up Law of Sines: $a/\sin A = c/\sin C$
 - Substitute: $a/\sin 43^\circ = 18.5/\sin 98^\circ$
 - Cross multiply: $a = 18.5 \cdot \sin 43^\circ / \sin 98^\circ$
 - Calculate: $a = 18.5 \cdot 0.6820 / 0.9903 \approx 12.7$ m
-

7. Answer: $d \approx 131.4$ km



- The remaining angle = $180^\circ - 65^\circ - 72^\circ = 43^\circ$
 - Set up Law of Sines with the triangle formed by the two ships and the port
 - $d/\sin 65^\circ = 120/\sin 43^\circ$
 - Calculate: $d = 120 \cdot \sin 65^\circ / \sin 43^\circ \approx 120 \cdot 0.9063 / 0.6820 \approx 131.4 \text{ km}$
-

8. Answer: B $\approx 62.0^\circ$

- Set up the Law of Sines: $\sin B / 31 = \sin 38^\circ / 22$
 - Solve for sin B: $\sin B = 31 \cdot \sin 38^\circ / 22$
 - Calculate sin B: $\sin B = 31 \cdot 0.6157 / 22 \approx 0.8676$
 - Find B: $B = \arcsin(0.8676) \approx 62.0^\circ$
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9. Answer: longest side $\approx 762.6 \text{ m}$

- Find the third angle: $C = 180^\circ - 78^\circ - 55^\circ = 47^\circ$
 - The largest side is opposite the largest angle (78°)
 - Set up: $s/\sin 78^\circ = 640/\sin 47^\circ$
 - Calculate: $s = 640 \cdot \sin 78^\circ / \sin 47^\circ \approx 640 \cdot 0.9781 / 0.7314 \approx 762.6 \text{ m}$
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10. Answer: PT $\approx 203.2 \text{ m}$

- Identify the triangle PQT with $PQ = 200 \text{ m}$, angle $QPT = 48^\circ$, angle $PQT = 69^\circ$
 - Find angle PTQ: $180^\circ - 48^\circ - 69^\circ = 63^\circ$
 - Apply Law of Sines: $PT/\sin 69^\circ = 200/\sin 63^\circ$
 - Calculate: $PT = 200 \cdot \sin 69^\circ / \sin 63^\circ \approx 200 \cdot 0.9336 / 0.8910 \approx 203.2 \text{ m}$
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