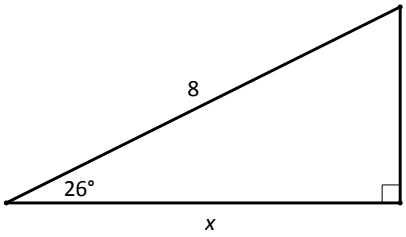
Lesson 9: Law of Cosines

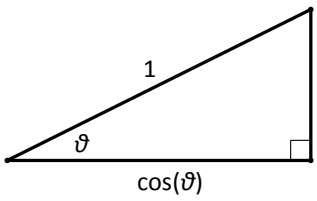
Classwork

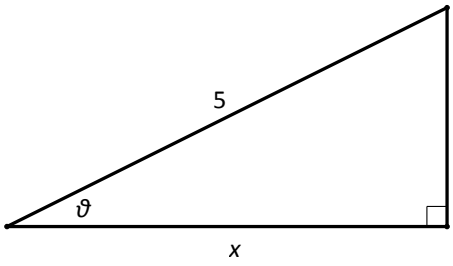
Exercises

1. Find the value of x in the triangle below.



2. Explain how the figures below are related. Then, describe x in terms of ϑ.





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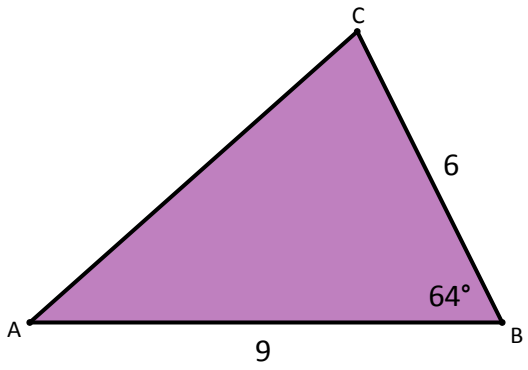
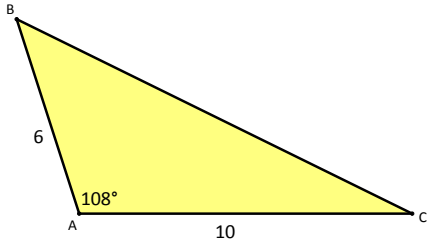
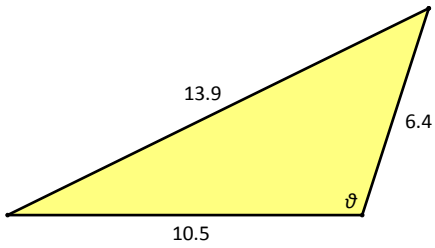
3. Find the length of side $\overline{AC}$ in the triangle below.



4. Points B and C are located at the edges of a large body of water. Point A is 6 km from point B and 10 km from point C. The angle formed between segments $\overline{BA}$ and $\overline{AC}$ is $108°$. How far apart are points B and C?



5. Use the law of cosines to find the value of ϑ in the triangle below.



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Problem Set

1. Consider the case of a triangle with sides 5, 12, and the angle between them $90°$.
   a. What is the easiest method to find the missing side?
   b. What is the easiest method to find the missing angles?
   c. Can you use the law of cosines to find the missing side? If so, perform the calculations. If not, show why not.
   d. Can you use the law of cosines to find the missing angles? If so, perform the calculations. If not, show why not.
   e. Consider a triangle with sides a, b, and the angle between them $90°$. Use the law of cosines to prove a well-known theorem. State the theorem.
   f. Summarize what you have learned in parts (a) through (e).

2. Consider the case of two line segments $\overline{CA}$ and $\overline{CB}$ of lengths 5 and 12, respectively, with $m\angle C = 180°$.
   a. Is ABC a triangle?
   b. What is the easiest method to find the distance between A and B?
   c. Can you use the law of cosines to find the distance between A and B? If so, perform the calculations. If not, show why not.
   d. Summarize what you have learned in parts (a) through (c).

3. Consider the case of two line segments $\overline{CA}$ and $\overline{CB}$ of lengths 5 and 12, respectively, with $m\angle C = 0°$.
   a. Is ABC a triangle?
   b. What is the easiest method to find the distance between A and B?
   c. Can you use the law of cosines to find the distance between A and B? If so, perform the calculations. If not, show why not.
   d. Summarize what you have learned in parts (a) through (c).

4. Consider the case of two line segments $\overline{CA}$ and $\overline{CB}$ of lengths 5 and 12, respectively, with $m\angle C > 180°$.
   a. Is the law of cosines consistent in being able to calculate the length of $\overline{AB}$ even using an angle this large? Try it for $m\angle C = 200°$, and compare your results to the triangle with $m\angle C = 160°$. Explain your findings.
   b. Consider what you have learned in Problems 1–4. If you were designing a computer program to be able to measure sides and angles of triangles created from different line segments and angles, would it make sense to use the law of cosines or several different techniques depending on the shape? Would a computer program created from the law of cosines have any errors based on different inputs for the line segments and angle between them?

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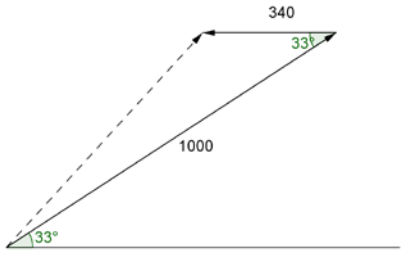
5. Consider triangles with the following measurements. If two sides are given, use the law of cosines to find the measure of the third side. If three sides are given, use the law of cosines to find the measure of the angle between a and b.
   a. $a = 4, b = 6, C = 35.$
   b. $a = 2, b = 3, C = 110.$
   c. $a = 5, b = 5, C = 36.$
   d. $a = 7.5, b = 10, C = 90.$
   e. $a = 4.4, b = 6.2, C = 9.$
   f. $a = 12, b = 5, C = 45.$
   g. $a = 3, b = 6, C = 60.$
   h. $a = 4, b = 5, c = 6.$
   i. $a = 1, b = 1, c = 1.$
   j. $a = 7, b = 8, c = 3.$
   k. $a = 6, b = 5.5, c = 6.5.$
   l. $a = 8, b = 5, c = 12.$
   m. $a = 4.6, b = 9, c = 11.9.$

6. A trebuchet launches a boulder at an angle of elevation of $33°$ at a force of $1000\ N$. A strong gale wind is blowing against the boulder parallel to the ground at a force of $340\ N$. The figure is shown below.



   a. What is the force in the direction of the boulder's path?
   b. What is the angle of elevation of the boulder after the wind has influenced its path?

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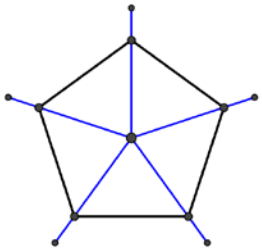
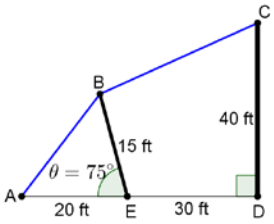
7. Cliff wants to build a tent for his son's graduation party. The tent is a regular pentagon, as illustrated below. How much guide wire (show in blue) does Cliff need to purchase to build this tent? Round your answers to the nearest thousandths.

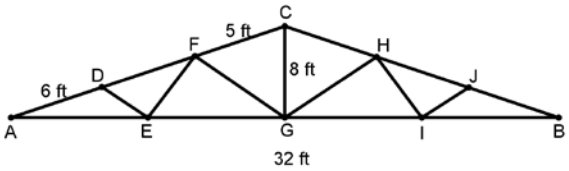


Overhead View



Side View

8. A roofing contractor needs to build roof trusses for a house. The side view of the truss is shown below. Given that G is the midpoint of $\overline{AB}$, E is the midpoint of $\overline{AG}$, I is the midpoint of $\overline{GB}$, $\overline{AB} = 32$ ft., $\overline{AD} = 6$ ft., $\overline{FC} = 5$ ft., and $\angle AGC = 90^{\circ}$. Find $\overline{DE}$, $\overline{EF}$, and $\overline{FG}$. Round your answers to the nearest thousandths.



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