Lesson 3.9 - Law of Cosines

Learning Objectives: SWBAT

1. Use the Law of Cosines to solve oblique triangles given SAS or SSS measurements

Making a connection

- Previously, we used the Law of Sines to solve for missing sides/angles of a triangle given AAS, ASA and SSA measurements.
- For situations where we are given SSS and SAS information, we will use the Law of Cosines Formulas

$$a^2 = b^2 + c^2 - 2bc\cos A$$

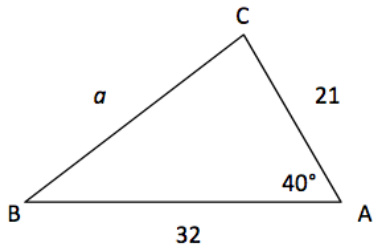
$$b^2 = a^2 + c^2 - 2ac\cos B$$

$$c^2 = b^2 + a^2 - 2ba\cos C$$

In the following example you will find the length of a side of a triangle using Law of Cosines.

Example 1:

Find the length of *a*.

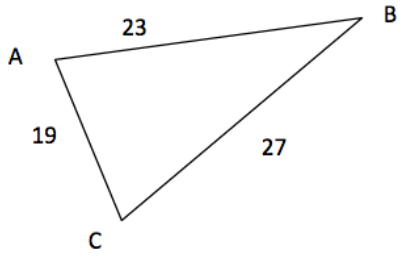


Write down known.	$b = 21, c = 32, \text{m}\angle A = 40°$
Law of Cosines	$a^2 = b^2 + c^2 - 2bc\cos A$
Substitute.	$a^2 = (21)^2 + (32)^2 - 2(21)(32)\cos 40°$
Simplify.	$a^2 = 441 + 1024 - 1344\cos 40°$
	$\sqrt{a^2} = \sqrt{441 + 1024 - 1344\cos 40°}$
Round to the nearest hundredth.	$a \approx 20.87$

In the following example you will find the measure of an angle of a triangle using Law of Cosines.

Example 2:

Find m∠A.



Write down known.	$a = 27, b = 19, c = 23$
Law of Cosines	$a^2 = b^2 + c^2 - 2bc\cos A$
Substitute.	$(27)^2 = (19)^2 + (23)^2 - 2(19)(23)\cos A$
Simplify.	$729 = 361 + 529 - 874\cos A$
	$729 = 1465 - 874\cos A$
Isolate $\cos A$.	$-736 = -874\cos A$
Find the inverse.	$\frac{736}{874} = \cos A$
Round to the nearest hundredth.	$\text{m}\angle A \approx 79.38°$

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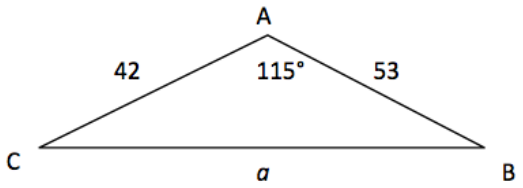
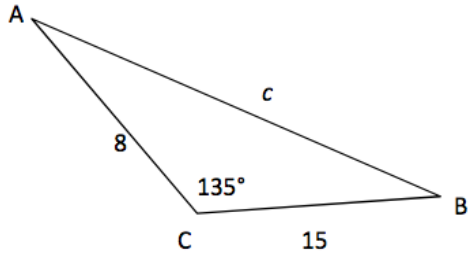
Practice

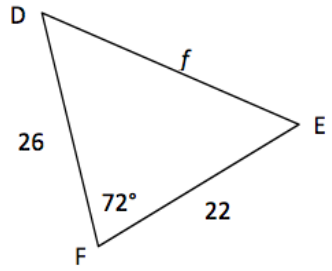
1. For ΔABC find a to the nearest hundredth.



2. For ΔABC find c to the nearest hundredth.



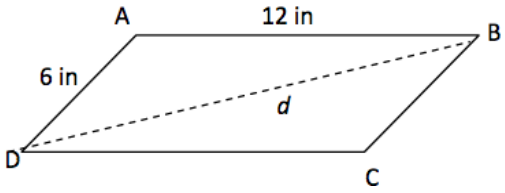
3. For ΔDEF find f to the nearest hundredth.



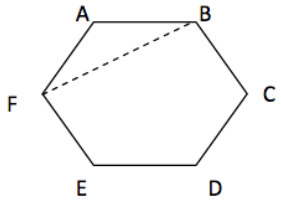
4. For ΔABC find the length of a to the nearest hundredth, given $b = 8, c = 23$, and $m\angle A = 29°$.

5. For ΔABC find the length of c to the nearest hundredth, given $a = 54, b = 47$, and $m\angle C = 85°$.

6. Find the length of the diagonal, d, of the parallelogram below to the nearest inch.



7. A regular hexagon has side lengths of 15 centimeters and angles that measure 120°. Find FB to the nearest centimeter.



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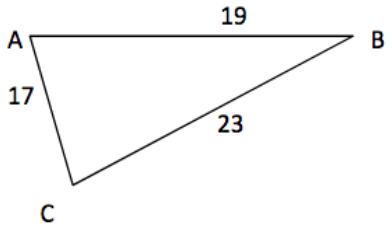
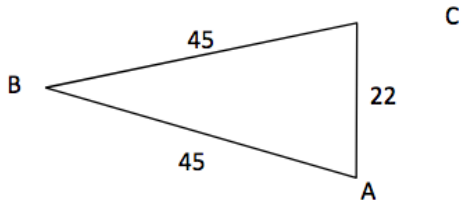
Practice

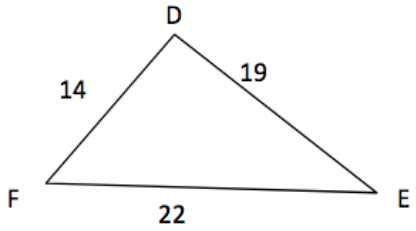
8. For ΔABC find m∠A to the nearest tenth of a degree.



9. For ΔABC find m∠B to the nearest tenth of a degree.



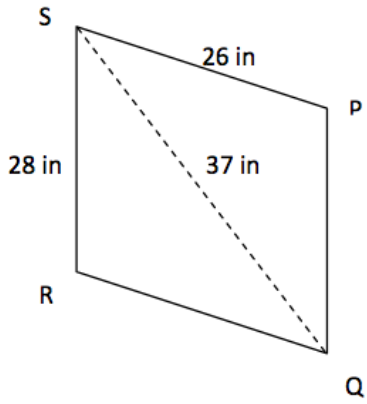
10. For ΔDEF find m∠E to the nearest tenth of a degree.



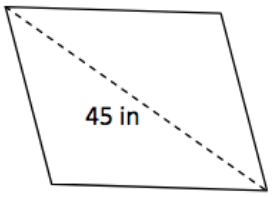
11. For ΔABC find m∠B to the nearest tenth, given $a = 7, b = 6,$ and $c = 5$.

12. For ΔDEF find m∠F to the nearest tenth, given $d = 38, e = 42,$ and $f = 47$.

13. Find m∠P for the parallelogram below to the tenth of a degree.



14. A rhombus has side lengths of 25 inches. The diagonal opposite the obtuse angles is 45 inches. What is the measure of the obtuse angle to the nearest degree?



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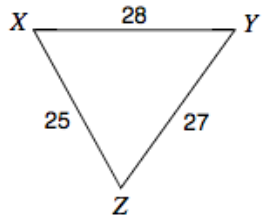
Solve each triangle. Round your answers to the nearest tenth.

11)



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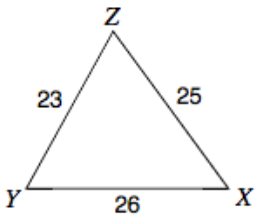
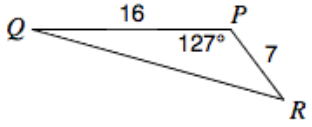
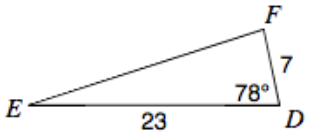


13)



14)



15) In $\triangle STR, m\angle S = 117.8°,\ r = 20.4,\ t = 22.1$

16) In $\triangle RPQ, q = 11,\ p = 22,\ m\angle R = 96°$

17) In $\triangle RST, s = 13,\ r = 30,\ t = 20$

18) In $\triangle ABC, a = 19.8,\ b = 19.1,\ c = 16.7$

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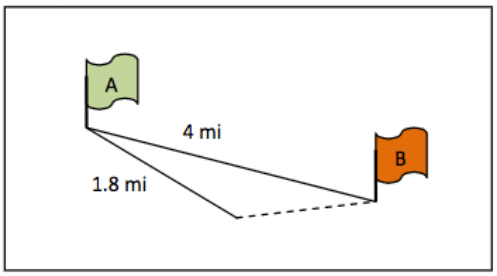
Practice

22. Peter has three sticks measuring 19 inches, 23 inches, and 27 inches. He lays them down to form a triangle. Find the measure of the angle enclosed by the 19 inch and 23 inch sides to the nearest degree.

23. Mary is orienteering across a large flat plain from Marker A to Marker B which are 4 miles apart. After walking 1.8 miles she realizes she is 6° off-course. To the nearest tenth of a mile, how far from Marker B is she when she realizes her error?



24. A navigator plots the course a plane is currently traveling. The plane is 300 miles from its destination. If it continues on its current course it will travel 325 miles and end up 125 miles due south of its destination. To the nearest degree, how many degrees is the plane off course?

38. ***Surveying*** To approximate the length of a marsh, a surveyor walks 380 meters from point A to point B. Then the surveyor turns 80° and walks 240 meters to point C (see figure). Approximate the length AC of the marsh.