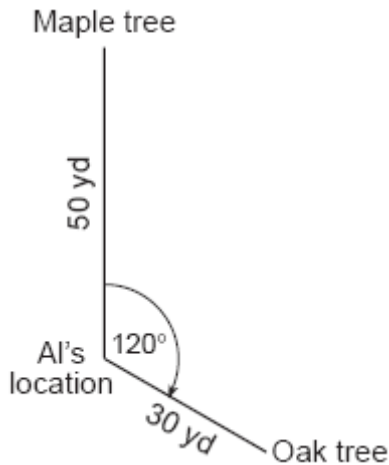


NAME: _____

1. 060817b, P.I. A2.A.73

Al is standing 50 yards from a maple tree and 30 yards from an oak tree in the park. His position is shown in the accompanying diagram. If he is looking at the maple tree, he needs to turn his head 120° to look at the oak tree.

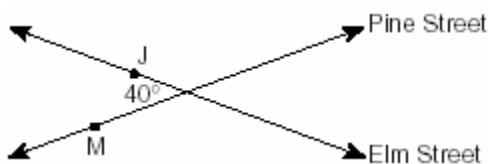


How many yards apart are the two trees?

[A] 70 [B] 58.3 [C] 75 [D] 65.2

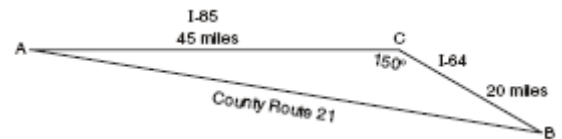
2. 010227b, P.I. A2.A.73

Two straight roads, Elm Street and Pine Street, intersect creating a 40° angle, as shown in the accompanying diagram. John's house (J) is on Elm Street and is 3.2 miles from the point of intersection. Mary's house (M) is on Pine Street and is 5.6 miles from the intersection. Find, to the *nearest tenth of a mile*, the direct distance between the two houses.



3. 060232b, P.I. A2.A.73

Kieran is traveling from city A to city B . As the accompanying map indicates, Kieran could drive directly from A to B along County Route 21 at an average speed of 55 miles per hour or travel on the interstates, 45 miles along I-85 and 20 miles along I-64. The two interstates intersect at an angle of 150° at C and have a speed limit of 65 miles per hour. How much time will Kieran save by traveling along the interstates at an average speed of 65 miles per hour?



4. 080329b, P.I. A2.A.73

A ship at sea is 70 miles from one radio transmitter and 130 miles from another. The angle between the signals sent to the ship by the transmitters is 117.4° . Find the distance between the two transmitters, to the *nearest mile*.

5. 010528b, P.I. A2.A.73

To measure the distance through a mountain for a proposed tunnel, surveyors chose points A and B at each end of the proposed tunnel and a point C near the mountain. They determined that $AC = 3,800$ meters, $BC = 2,900$ meters, and $m\angle ACB = 110$. Draw a diagram to illustrate this situation and find the length of the tunnel, to the *nearest meter*.

TRIANGLES: Law of Cosines

www.jmap.org

NAME: _____

6. fall9929b, P.I. A2.A.73

The Vietnam Veteran's Memorial in Washington, DC consists of two walls of black, polished granite, each 246.75 feet long, which meet at an angle of 125.2° . If extended, the west wall would reach to the Lincoln Memorial, 900 feet away from the end of the wall and the east wall would reach to the Washington Monument, 3,500 feet away from the end of the wall. Find the distance between the Lincoln Memorial and the Washington Monument to the *nearest foot*.

7. 060127b, P.I. A2.A.73

A wooden frame is to be constructed in the form of an isosceles trapezoid, with diagonals acting as braces to strengthen the frame. The sides of the frame each measure 5.30 feet, and the longer base measures 12.70 feet. If the angles between the sides and the longer base each measure 68.4° , find the length of one brace to the *nearest tenth of a foot*.

8. 060434b, P.I. A2.A.73

A surveyor is mapping a triangular plot of land. He measures two of the sides and the angle formed by these two sides and finds that the lengths are 400 yards and 200 yards and the included angle is 50° . What is the measure of the third side of the plot of land, to the *nearest yard*? What is the area of this plot of land, to the *nearest square yard*?

9. 010929b, P.I. A2.A.73

In $\triangle ABC$, $a = 24$, $b = 36$, and $c = 30$. Find $m\angle A$ to the *nearest tenth of a degree*.

10. 080828b, P.I. A2.A.73

During a training exercise in the Mojave Desert, two military vehicles left the base camp at the same time, one traveling at an average speed of 25 miles per hour and the other at an average speed of 50 miles per hour. Each vehicle traveled along a level, straight route. If the exercise requires the two vehicles to be 65 miles apart after traveling for 1 hour, what must the angle between the two routes be, to the *nearest degree*?

11. 080934b, P.I. A2.A.73

Firefighters dug three trenches in the shape of a triangle to prevent a fire from completely destroying a forest. The lengths of the trenches were 250 feet, 312 feet, and 490 feet. Find, to the *nearest degree*, the smallest angle formed by the trenches. Find the area of the plot of land within the trenches, to the *nearest square foot*.

[1] A _____

[4] 3.8, and the Law of Cosines is used.

[3] Appropriate work is shown, but one computational or rounding error is made.

[2] Appropriate work is shown, but one computational error and one rounding error are made.

or [2] The Law of Cosines is shown, but sine is used instead of cosine, such as

$x^2 = 3.2^2 + 5.6^2 - 2(3.2)(5.6)(\sin 40)$, but an appropriate answer is determined, based on that error.

[1] Substitution into the Law of Cosines is used, but no further work is shown.

or [1] 3.8, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[2] incorrect procedure.

[4] 0.15 hour or 9 minutes or an appropriately rounded answer, and appropriate work is shown, such as using the Law of Cosines.

[3] Appropriate work is shown, but one computational or rounding error is made.

[2] The correct distance along County Route 21 is found, but no further work or incorrect work is shown.

or [2] Appropriate work is shown, but one computational and one rounding error are made.

[1] The Pythagorean theorem is used to find the distance along County Route 21, and this distance is used to compare travel times.

or [1] 0.15 hour or an equivalent answer, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[3] incorrect procedure.

[4] 174, and appropriate work is shown, such as the use of the Law of Cosines.

[3] Appropriate work is shown, but one computational or rounding error is made.

[2] Appropriate work is shown, but two or more computational or rounding errors are made.

or [2] One conceptual error is made when applying the Law of Cosines, but an appropriate answer is found.

[1] Correct substitution is made into the Law of Cosines, but no further correct work is shown.

or [1] 174, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[4] incorrect procedure.

[4] 5,513 and a correct diagram is drawn, and appropriate work is shown, such as using the Law of Cosines.

[3] Appropriate work is shown, but one computational or rounding error is made.

or [3] 5,513, and appropriate work is shown, but no diagram is drawn.

or [3] Appropriate work is shown, but the calculations are performed in radians, resulting in an answer of 6,698.

or [3] An incorrect diagram is drawn, but an appropriate solution is found using the Law of Cosines.

[2] Appropriate work is shown, but two or more computational or rounding errors are made.

or [2] Appropriate work is shown, but one conceptual error is made.

or [2] Appropriate work is shown, but an incorrect substitution is made into the Law of Cosines, but an appropriate solution is found.

[1] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.

or [1] Correct substitution is made into the Law of Cosines, but no further correct work is shown.

or [1] A correctly labeled diagram is drawn, but no further correct work is shown.

or [1] 5,513, but no work is shown and no diagram is drawn.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[5] incorrect procedure.

[4] 4506 and shows an appropriate application of the Law of Cosines such as

$$a^2 = 1146.75^2 + 3746.75^2 - 2(1146.75)(3746.75)\cos 125.2^\circ.$$

[3] Makes an appropriate application of the Law of Cosines, but does not add the wall length to the distances. (answer 4086)

or [3] Uses the appropriate method, but makes a minor mathematical or rounding error.

or [3] 4506 showing a correct diagram but showing no Law of Cosines.

[2] Correctly uses the Law of Cosines, with or without the wall added, but does not find the square root.

or [2] Uses Law of Cosines without the wall added and makes a minor mathematical mistake.

or [2] Finds the distance between the ends of the two walls (answer 438) using the Law of Sines or Cosines.

[1] Obtains the correct answer of 4506, but does not show any work.

or [1] Sets up diagram with correct sides (1146.75 and 3746.75) and angle, but does not solve problem.

[0] Response is completely incorrect, irrelevant, or incoherent; or is a correct response that was obtained by an obviously

[6] incorrect procedure

- [4] 11.8, and an appropriate application of the Law of Cosines is shown.
- [3] Appropriate work is shown, but one computational or rounding error is made.
- or [3] The Law of Cosines is correctly applied, but the square root is not found.
- [2] The Law of Cosines is applied correctly, and correct substitutions are shown, but no further work is shown.
- or [2] Appropriate work is shown, but more than one computational error is made.
- [1] The diagram is set up with the correct sides and angles, and the Law of Cosines is written, but substitution is not made.
- or [1] The diagram is set up with the correct sides and angles, but no further work is shown.
- or [1] 11.8, but no work is shown.
- [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
-

- [6] 312 and 30,642, and appropriate work is shown, such as using the Law of Cosines and the area formula.
- [5] Appropriate work is shown, but one computational or rounding error is made.
- [4] Appropriate work is shown, but two or more computational or rounding errors are made.
- or [4] Appropriate work is shown, but one conceptual error is made.
- or [4] Appropriate work is shown, but the square root is not computed to find the length of the third side, but an appropriate area is found.
- or [4] The length of the third side is found correctly, but no further correct work is shown.
- [3] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.
- [2] The area of the triangle is found correctly, but no further correct work is shown.
- or [2] 312 and 30,642, but no work is shown.
- [1] Appropriate work is shown to find the area of the triangle, but one computational or rounding error is made, and no further correct work is shown.
- or [1] 312 or 30,642, but no work is shown.
- [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
-

- [4] 41.4, and appropriate work is shown.
 [3] Appropriate work is shown, but one computational or rounding error is made.
 [2] Appropriate work is shown, but two or more computational or rounding errors are made.
 or [2] Appropriate work is shown, but one conceptual error is made.
 [1] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.
 or [1] A correct substitution is made into the Law of Cosines, but no further correct work is shown.
 or [1] 41.4, but no work is shown.
 [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
-
- [9] [4] 116, and appropriate work is shown, such as the use of the Law of Cosines.
 [3] Appropriate work is shown, but one computational or rounding error is made.
 [2] Appropriate work is shown, but two or more computational or rounding errors are made.
 or [2] Appropriate work is shown, but one conceptual error is made.
 or [2] Correct substitution is made into the Law of Cosines, but no further correct work is shown.
 [1] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.
 or [1] A complete and correctly labeled diagram is drawn, but no further correct work is shown.
 or [1] 116, but no work is shown.
 [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
-
- [10]

- [6] 26 and 33,443, and appropriate work is shown, such as using the Law of Cosines and finding the area of the triangle. [Allow full credit if the student uses 26 and finds $A = 33,509$.]
 [5] Appropriate work is shown, but one computational or rounding error is made.
 [4] Appropriate work is shown, but two or more computational or rounding errors are made.
 or [4] Appropriate work is shown, but one conceptual error is made.
 or [4] Appropriate work is shown to find 26, but no further correct work is shown.
 [3] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.
 or [3] The area is found using Hero(n)'s formula, but no further correct work is shown.
 [2] Appropriate work is shown, but two conceptual errors are made.
 or [2] 26 and either 33,509 or 33,443, but no work is shown.
 [1] Appropriate work is shown, but two conceptual errors and one computational or rounding error are made.
 or [1] A correct substitution is made into the Law of Cosines, but no further correct work is shown.
 or [1] 26 or 33,509 or 33,443, but no work is shown.
 [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
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- [11]