

Section 8-6: Solving Problems Using Trigonometric Ratios

1. 060419a, P.I. A.A.44

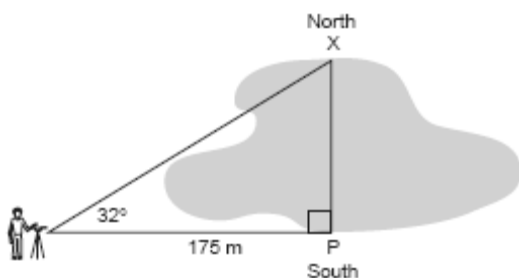
The angle of elevation from a point 25 feet from the base of a tree on level ground to the top of the tree is 30° . Which equation can be used to find the height of the tree?

[A] $\tan 30^\circ = \frac{x}{25}$ [B] $\sin 30^\circ = \frac{x}{25}$

[C] $30^2 + 25^2 = x^2$ [D] $\cos 30^\circ = \frac{x}{25}$

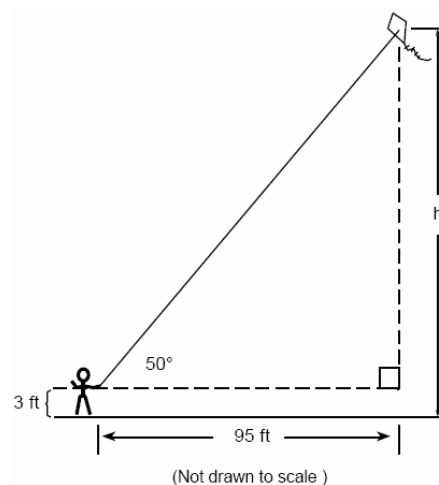
2. 060030a, P.I. A.A.44

A surveyor needs to determine the distance across the pond shown in the accompanying diagram. She determines that the distance from her position to point P on the south shore of the pond is 175 meters and the angle from her position to point X on the north shore is 32° . Determine the distance, PX , across the pond, rounded to the *nearest meter*.



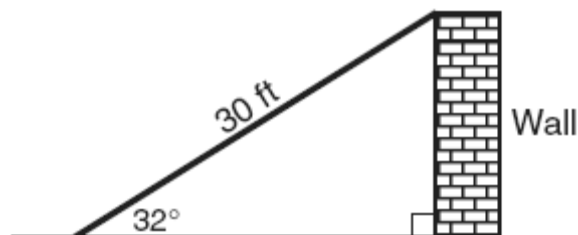
3. 069934a, P.I. A.A.44

Joe is holding his kite string 3 feet above the ground, as shown in the accompanying diagram. The distance between his hand and a point directly under the kite is 95 feet. If the angle of elevation to the kite is 50° , find the height, h , of his kite, to the *nearest foot*.



4. 080724a, P.I. A.A.44

The accompanying diagram shows a ramp 30 feet long leaning against a wall at a construction site.

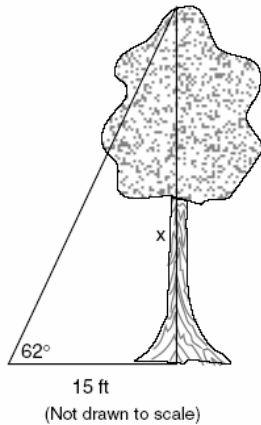


If the ramp forms an angle of 32° with the ground, how high above the ground, to the *nearest tenth*, is the top of the ramp?

- [A] 18.7 ft [B] 15.9 ft
[C] 56.6 ft [D] 25.4 ft

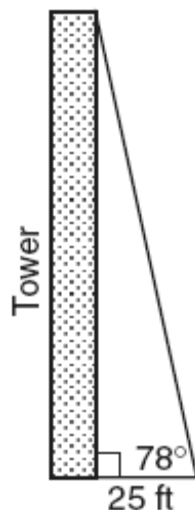
5. 010135a, P.I. A.A.44

Find, to the *nearest tenth of a foot*, the height of the tree represented in the accompanying diagram.



6. 010735a, P.I. A.A.44

From a point on level ground 25 feet from the base of a tower, the angle of elevation to the top of the tower is 78° , as shown in the accompanying diagram. Find the height of the tower, to the *nearest tenth of a foot*.



7. 010531a, P.I. A.A.44

In the accompanying diagram, a ladder leaning against a building makes an angle of 58° with level ground. If the distance from the foot of the ladder to the building is 6 feet, find, to the *nearest foot*, how far up the building the ladder will reach.



8. 080536a, P.I. A.A.44

A tree casts a shadow that is 20 feet long. The angle of elevation from the end of the shadow to the top of the tree is 66° . Determine the height of the tree, to the *nearest foot*.

9. 010235a, P.I. A.A.44

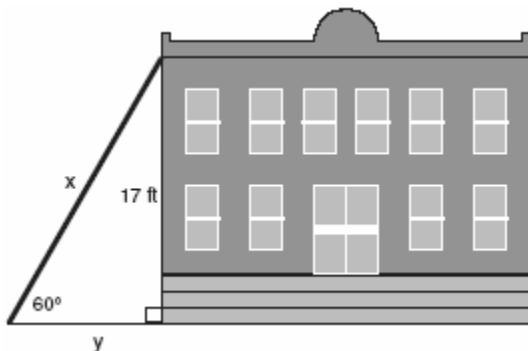
Draw and label a diagram of the path of an airplane climbing at an angle of 11° with the ground. Find, to the *nearest foot*, the ground distance the airplane has traveled when it has attained an altitude of 400 feet.

10. 080033a, P.I. A.A.44

A 10-foot ladder is to be placed against the side of a building. The base of the ladder must be placed at an angle of 72° with the level ground for a secure footing. Find, to the *nearest inch*, how far the base of the ladder should be from the side of the building and how far up the side of the building the ladder will reach.

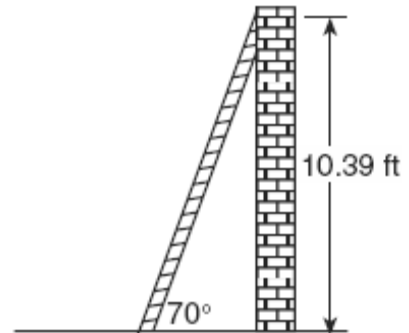
11. 080231a, P.I. A.A.44

In the accompanying diagram, x represents the length of a ladder that is leaning against a wall of a building, and y represents the distance from the foot of the ladder to the base of the wall. The ladder makes a 60° angle with the ground and reaches a point on the wall 17 feet above the ground. Find the number of feet in x and y .



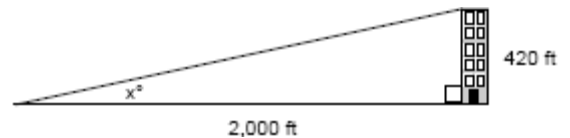
12. 010638a, P.I. A.A.44

As shown in the accompanying diagram, a ladder is leaning against a vertical wall, making an angle of 70° with the ground and reaching a height of 10.39 feet on the wall. Find, to the *nearest foot*, the length of the ladder. Find, to the *nearest foot*, the distance from the base of the ladder to the wall.



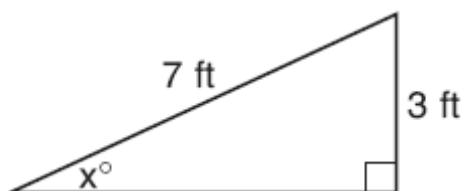
13. 089927a, P.I. A.A.43

A person standing on level ground is 2,000 feet away from the foot of a 420-foot-tall building, as shown in the accompanying diagram. To the *nearest degree*, what is the value of x ?



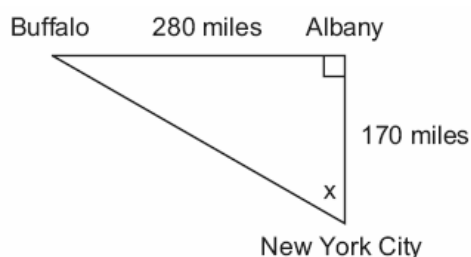
14. 060735a, P.I. A.A.43

Ron and Francine are building a ramp for performing skateboard stunts, as shown in the accompanying diagram. The ramp is 7 feet long and 3 feet high. What is the measure of the angle, x , that the ramp makes with the ground, to the *nearest tenth of a degree*?



15. 060231a, P.I. A.A.43, G.G.48

As seen in the accompanying diagram, a person can travel from New York City to Buffalo by going north 170 miles to Albany and then west 280 miles to Buffalo.

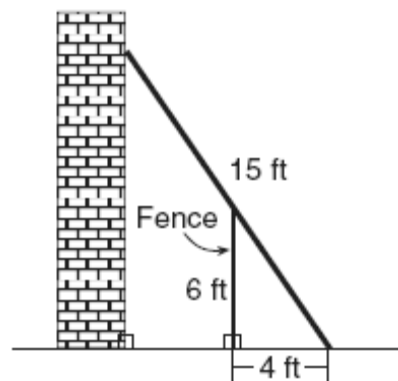


a If an engineer wants to design a highway to connect New York City directly to Buffalo, at what angle, x , would she need to build the highway? Find the angle to the *nearest degree*.

b To the *nearest mile*, how many miles would be saved by traveling directly from New York City to Buffalo rather than by traveling first to Albany and then to Buffalo?

16. 010438a, P.I. A.A.43

In the accompanying diagram, the base of a 15-foot ladder rests on the ground 4 feet from a 6-foot fence.

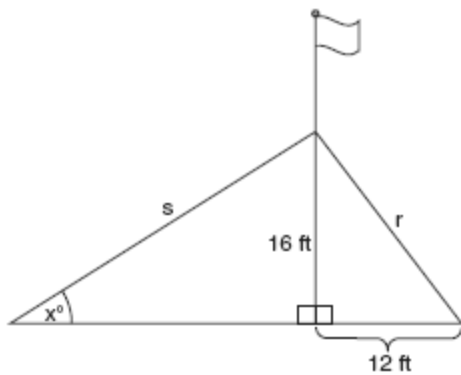


a If the ladder touches the top of the fence and the side of a building, what angle, to the *nearest degree*, does the ladder make with the ground?

b Using the angle found in part *a*, determine how far the top of the ladder reaches up the side of the building, to the *nearest foot*.

17. 060539a, P.I. A.A.43

The accompanying diagram shows a flagpole that stands on level ground. Two cables, r and s , are attached to the pole at a point 16 feet above the ground. The combined length of the two cables is 50 feet. If cable r is attached to the ground 12 feet from the base of the pole, what is the measure of the angle, x , to the *nearest degree*, that cable s makes with the ground?



18. 080133a, P.I. A.A.44

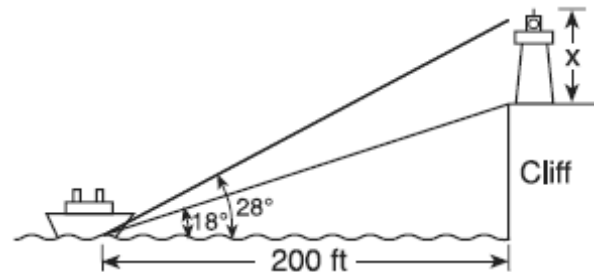
A ship on the ocean surface detects a sunken ship on the ocean floor at an angle of depression of 50° . The distance between the ship on the surface and the sunken ship on the ocean floor is 200 meters. If the ocean floor is level in this area, how far above the ocean floor, to the *nearest meter*, is the ship on the surface?

19. 060639a, P.I. A.A.44

A person measures the angle of depression from the top of a wall to a point on the ground. The point is located on level ground 62 feet from the base of the wall and the angle of depression is 52° . How high is the wall, to the *nearest tenth of a foot*?

20. 010838a, P.I. A.A.44

A lighthouse is built on the edge of a cliff near the ocean, as shown in the accompanying diagram. From a boat located 200 feet from the base of the cliff, the angle of elevation to the top of the cliff is 18° and the angle of elevation to the top of the lighthouse is 28° . What is the height of the lighthouse, x , to the *nearest tenth of a foot*?



21. 080108b, P.I. A.A.44

At Mogul's Ski Resort, the beginner's slope is inclined at an angle of 12.3° , while the advanced slope is inclined at an angle of 26.4° . If Rudy skis 1,000 meters down the advanced slope while Valerie skis the same distance on the beginner's slope, how much longer was the horizontal distance that Valerie covered?

- [A] 895.7 m [B] 977.0 m
[C] 81.3 m [D] 231.6 m

[1] A

[3] 109 meters and appropriate work is shown by using an appropriate trigonometric ratio,

such as $\tan 32^\circ = \frac{y}{175}$.

[2] 109 meters but one rounding error is made.

or [2] The student uses an appropriate trigonometric function with an inverted ratio,

such as $\tan 32^\circ = \frac{175}{y}$, but completes the

calculation appropriately, such as showing 280 meters.

[1] The student uses an incorrect trigonometric ratio but completes the calculation appropriately.

or [1] The student uses an inverted tangent ratio and makes one computational or rounding error.

or [1] The student uses the correct trigonometric ratio but solves it incorrectly or does not solve it at all.

or [1] 109 meters but no work or explanation 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] 116 and an appropriate method is shown.

[3] An appropriate method is shown, but the answer is left in an inappropriate form, such as 116.2.

or [3] An appropriate method is shown, but 3 feet is not added, and the answer is left 113.

or [3] Tangent function is used, but computational mistakes are made, but 3 feet is added to the incorrect value and the answer is found correctly.

[2] An incorrect trigonometric function is used, 3 feet is added, and the answer is rounded correctly.

or [2] Tangent function is used, but computational mistakes are made, and 3 feet is not added to an incorrect answer.

[1] 116 and no work is shown.

or [1] An incorrect trigonometric function is used, and 3 feet is added to the incorrect answer, but the answer is rounded incorrectly.

[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] B

[4] 28.2, and an appropriate equation is

shown, such as $\tan 62^\circ = \frac{x}{15}$.

[3] Appropriate work is shown, but the answer is rounded incorrectly.

or [3] The student uses the correct tangent function and rounds the answer, but makes one computational error.

[2] The student uses the correct tangent function, but makes several errors.

or [2] An incorrect trigonometric function is used, but appropriate work is shown.

[1] The tangent function is indicated, but the ratio is set up incorrectly.

or [1] 28.2, 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

[5] incorrect procedure.

[2] 117.6, and appropriate work is shown,
such as $\tan 78^\circ = \frac{x}{25}$.

[1] Appropriate work is shown, but one
computational or rounding error is made.
or [1] Appropriate work is shown, but one
conceptual error is made, such as using an
incorrect trigonometric function, but an
appropriate solution is found.
or [1] A correct trigonometric equation is
written, but no further correct work is shown.
or [1] 117.6, 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
[6] incorrect procedure.

[2] 10, and appropriate work is shown.
[1] Appropriate work is shown, but one
computational or rounding error is made.
or [1] Appropriate work is shown, but one
conceptual error is made, such as using an
incorrect trigonometric function.
or [1] Appropriate work is shown, but the
length of the ladder is found.
or [1] 10, 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
[7] incorrect procedure.

[3] 45, and appropriate work is shown, such
as $\tan 66^\circ = \frac{x}{20}$.

[2] A correct trigonometric ratio is used, and
values are substituted correctly, but one
computational or rounding error is made, or
the calculator is left in radian mode.

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

or [1] Appropriate work is shown, but one
conceptual error is made, such as using an
incorrect trigonometric ratio.

or [1] An incorrect diagram is drawn, but an
appropriate solution is found.

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

or [1] A correct trigonometric ratio is written,
but no further correct work is shown.

or [1] 45, 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
[8] incorrect procedure.

[4] 2,058, and appropriate work is shown, such as the accompanying diagram and equation.



[3] Appropriate work is shown, including a correct diagram and the use of the tangent function, but one computational error is made.

or [3] Appropriate work is shown, including a correct diagram and the use of the tangent function, but the answer is not rounded or is rounded incorrectly.

[2] A correct diagram is drawn, but an incorrect trigonometric function is selected, but it is solved and rounded appropriately.

or [2] A correct diagram is drawn and the tangent function is selected, but no further work is shown.

or [2] An incorrect diagram is drawn, but the appropriate trigonometric function, based on the drawing, is selected, solved, and rounded appropriately.

[1] An incorrect diagram is drawn and an incorrect trigonometric function is selected, but it is solved and rounded appropriately.

or [1] Only a correct diagram is drawn.

or [1] 2,058, 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

[9] incorrect procedure.

[4] 114" (9 feet 6 inches) and 37" (3 feet 1 inch) and appropriate work is shown, such as

$$\sin 72^\circ = \frac{x}{10} \text{ and } \cos 72^\circ = \frac{y}{10} \text{ or use of the}$$

Pythagorean theorem.

[3] An incorrect diagram is drawn, but appropriate work and an appropriate solution for that diagram are shown.

or [3] Appropriate work is shown, but the answers are rounded to the nearest foot and then converted to inches, arriving at 120" and 36".

or [3] The setup is correct, but the answers are not converted to the nearest inch.

[2] One correct dimension is shown, such as 114" (9 feet 6 inches) or 37" (3 feet 1 inch).

or [2] Only one error involving interchanging sine and cosine is made.

or [2] An incorrect diagram is drawn, and the solution is appropriate for the diagram but is not rounded to the nearest inch.

[1] The student switches sine and cosine and does not round to the nearest inch.

or [1] The student uses the correct trigonometric function to compute one side correctly but does not convert it to the nearest inch.

or [1] 114" (9 feet 6 inches) and 37" (3 feet 1 inch) 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

[10] incorrect procedure.

[4] $x = 19.62990915$ and $y = 9.814954576$ or equivalent answers, and appropriate work is shown, such as $\sin 60^\circ = \frac{17}{x}$ and

$\tan 60^\circ = \frac{17}{y}$ or the Pythagorean theorem.

[3] Appropriate work is shown, but one computational or rounding error is made.
or [3] Appropriate work is shown, and the correct answers are found, but not identified.

[2] Appropriate work is shown, but one conceptual error is made, such as

$$\sin 60^\circ = \frac{x}{17}.$$

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

[1] Appropriate work is shown, but two conceptual errors are made, such as

$$\sin 60^\circ = \frac{x}{17} \text{ and } \tan 60^\circ = \frac{y}{17}.$$

or [1] $x = 19.62990915$ and $y = 9.814954576$ or equivalent answers, 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

[11] incorrect procedure.

[4] Length of ladder = 11 and distance from the base of the ladder to the wall = 4, and appropriate work is shown, such as using sine and then tangent or the Pythagorean theorem.

[3] Appropriate work is shown, but one computational or rounding error is made.
or [3] Appropriate work is shown, but the correct answers are not labeled or are labeled incorrectly.

[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, such as using one incorrect trigonometric ratio.

or [2] Appropriate work is shown, but only the length of the ladder or the distance from the base of the ladder to the wall is found.

or [2] Two correct trigonometric equations are written, 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] Only one correct trigonometric equation is written, and no further correct work is shown.

or [1] Length of ladder = 11 and distance from the base of the ladder to the wall = 4, but no work is shown.

[0] Length of ladder = 11 or distance from the base of the ladder to the wall = 4, but no work is shown.

or [0] 11 and 4, but no work is shown, and the solutions are not labeled.

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

[12] obviously incorrect procedure.

[3] 12 and the equation $\tan x = \frac{420}{2000} = .21$ is

shown.

or [3] 12 and the Pythagorean theorem and an appropriate trigonometric function are correctly used.

[2] Tan function is correctly used, but the answer is not rounded, such as 11.859.

or [2] The setup is correct, but one computational mistake is made, and an appropriate angle is found.

or [2] The answer is incorrectly expressed, such as $\tan x = 12$.

[1] The tan function is set up correctly, but the angle is not computed.

or [1] 12 and no work is shown.

or [1] 12 and $\sin x = \frac{420}{2000}$ is used.

or [1] 78 and $\cos x = \frac{420}{2000}$ is used.

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

[13] incorrect procedure.

[2] 25.4, and appropriate work is shown, such as solving the equation $\sin x = \frac{3}{7}$.

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

or [1] Appropriate work is shown, but one conceptual error is made, such as using an incorrect trigonometric function.

or [1] A correct trigonometric equation is written, but no further correct work is shown.

or [1] 25.4, 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

[14] incorrect procedure.

a [2] 59, and the equation $\tan x = \frac{280}{170}$ is

shown, or the Pythagorean theorem is used first to find the hypotenuse, and either sine or cosine is used correctly to find x.

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

or [1] 59, but no work is shown.

b [2] 122, if the Pythagorean theorem is used or if a trigonometric function of the angle is used before it was rounded to 59° .

or [2] 120, if $\cos 59 = \frac{170}{hyp}$ is used.

or [2] 123, if $\sin 59 = \frac{170}{hyp}$ is used.

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

or [1] 122 or 120 or 123, but no work is shown.

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

[15] obviously incorrect procedure.

- a [2] 56, and appropriate work is shown, such as $\tan A = \frac{6}{4}$ or finding the hypotenuse and then using sine or cosine or using proportional sides of similar triangles.
 [1] Appropriate work is shown, but one computational or rounding error is made.
 or [1] Appropriate work is shown, but one conceptual error is made.
 or [1] The length of the hypotenuse is found correctly, but no further correct work is shown.
 or [1] 56, but no work is shown.
 b [2] 12, and appropriate work is shown, such as $\sin 56 = \frac{h}{15}$.
 or [2] An appropriate answer is found based on an incorrect angle found in part a.
 [1] Appropriate work is shown, but one computational or rounding error is made.
 or [1] Appropriate work is shown, but one conceptual error is made.
 or [1] 12, but no work is shown.
 a and b [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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- [16]

- [4] 32, and appropriate work is shown, such as $12^2 + 16^2 = r^2$, $50 - r = s$, and $\sin x = \frac{16}{30}$.
 [3] Appropriate work is shown, but one computational error is made.
 or [3] Appropriate work is shown to find $r = 20$ and $s = 30$ and the trigonometric equation $\sin x = \frac{16}{30}$ is written, but it is not solved or is solved incorrectly.
 [2] Appropriate work is shown, but two or more computational errors are made.
 or [2] Appropriate work is shown, but one conceptual error is made, such as using an incorrect trigonometric function to find the angle.
 or [2] The lengths of r and s are found correctly, but no further correct work is shown.
 or [2] Incorrect lengths are found for r and s , but the sine function is used correctly to find an appropriate angle.
 [1] Appropriate work is shown, but one conceptual error and one computational error are made.
 or [1] The length of r is found correctly, but no further correct work is shown.
 or [1] 32, 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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- [17]

[4] 153, and appropriate work is shown, such as $\sin 50^\circ = \frac{x}{200}$.

[3] An appropriate analysis is shown, but one computational or rounding error is made.

[2] An incorrect trigonometric function is used, such as $\cos 50^\circ = \frac{x}{200}$, but it is carried

to an appropriate final answer and is rounded correctly.

[1] An incorrect trigonometric function is used and solved appropriately, but it is rounded incorrectly.

or [1] Only an appropriate diagram is shown.

or [1] 153, but no work is shown.

[0] Use of the Pythagorean theorem, such as $200^2 = 50^2 + x^2$, is shown.

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

[18] obviously incorrect procedure.

[4] 79.4, and appropriate work is shown, such as $\tan 52 = \frac{x}{62}$.

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

or [3] An incorrectly labeled diagram is drawn, but the appropriate trigonometric function is used, and an appropriate answer is found.

[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, such as using an incorrect trigonometric function or ratio.

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

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

or [1] A correct equation is written, but no further correct work is shown.

or [1] An incorrectly labeled diagram is drawn, but an appropriate equation is written, but no further correct work is shown.

or [1] 79.4, 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

[19] incorrect procedure.

[4] 41.4, and appropriate work is shown, such as $200 \tan 28^\circ - 200 \tan 18^\circ$.

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

or [3] Appropriate work is shown to find the correct height of the cliff and the correct combined height of the lighthouse and the cliff, but they are not subtracted.

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

[2] Appropriate work is shown, but one conceptual error is made, such as using an incorrect trigonometric function.

or [2] Appropriate work is shown to find the correct height of the cliff or the correct combined height of the lighthouse and the cliff, 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 correct equation is written to find the height of the lighthouse, but no further correct work is shown.

or [1] 41.4, but no work is shown.

[0] The correct height of the cliff or the correct combined height of the lighthouse and cliff is found, but no work is shown.

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

[20] obviously incorrect procedure.

[21] C