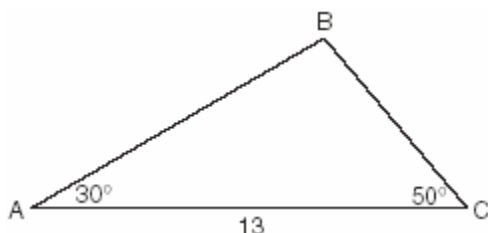*A2.A.73: Solve for an unknown side or angle, using the Law of Sines or the Law of Cosines*

1. 080214b, P.I. A2.A.73
    In the accompanying diagram of $\triangle ABC$, $m\angle A = 30$, $m\angle C = 50$, and $AC = 13$.
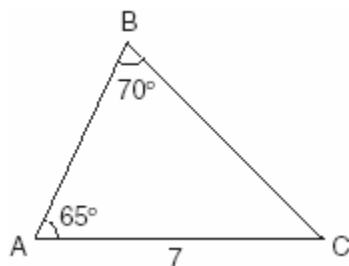

    What is the length of side $\overline{AB}$ to the *nearest tenth*?

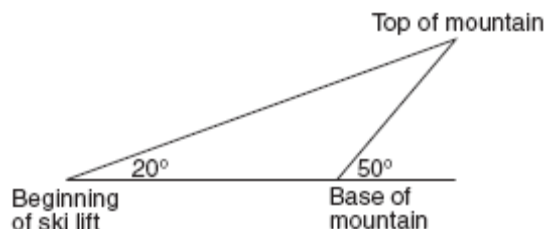   [A] 11.5   [B] 12.0   [C] 10.1   [D] 6.6

2. 080131b, P.I. A2.A.73
    In the accompanying diagram of $\triangle ABC$, $m\angle A = 65$, $m\angle B = 70$, and the side opposite vertex B is 7. Find the length of the side opposite vertex A, and find the area of $\triangle ABC$.
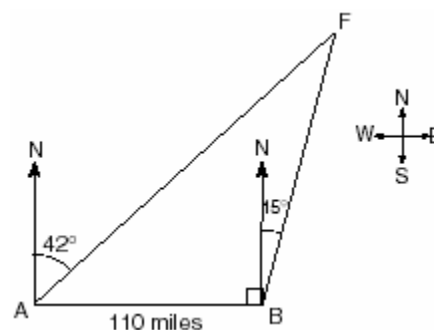

3. 080421b, P.I. A2.A.73
    A ski lift begins at ground level 0.75 mile from the base of a mountain whose face has a 50° angle of elevation, as shown in the accompanying diagram. The ski lift ascends in a straight line at an angle of 20°. Find the length of the ski lift from the beginning of the ski lift to the top of the mountain, to the *nearest hundredth of a mile*.

4. 060527b, P.I. A2.A.73
    As shown in the accompanying diagram, two tracking stations, A and B, are on an east-west line 110 miles apart. A forest fire is located at F, on a bearing 42° northeast of station A and 15° northeast of station B. How far, to the *nearest mile*, is the fire from station A?

5. 060622b, P.I. A2.A.73
    In $\triangle ABC$, $m\angle A = 53$, $m\angle B = 14$, and $a = 10$. Find b to the *nearest integer*.
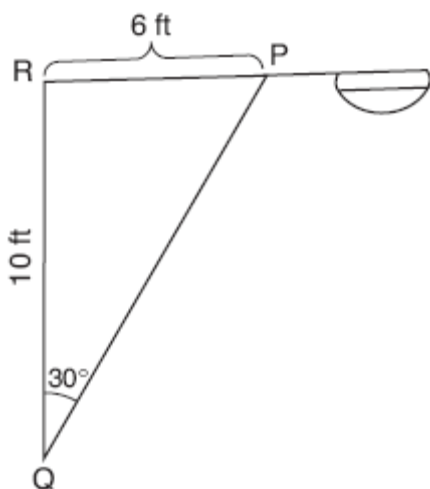
6. 010631b, P.I. A2.A.73

The Vietnam Veterans Memorial in Washington, D.C., is made up of two walls, each 246.75 feet long, that meet at an angle of 125.2°. Find, to the *nearest foot*, the distance between the ends of the walls that do not meet.
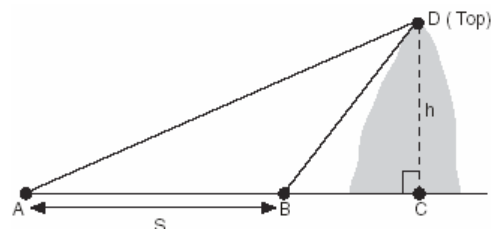
7. 060728b, P.I. A2.A.73

In the accompanying diagram of a streetlight, the light is attached to a pole at R and supported by a brace, $\overline{PQ}$, $RQ = 10$ feet, $RP = 6$ feet, $\angle PRQ$ is an obtuse angle, and $m\angle PQR = 30$. Find the length of the brace, $\overline{PQ}$, to the *nearest foot.*
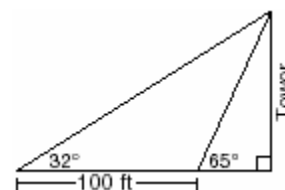

8. 060231b, P.I. A2.A.73

A ship at sea heads directly toward a cliff on the shoreline. The accompanying diagram shows the top of the cliff, D, sighted from two locations, A and B, separated by distance S. If $m\angle DAC = 30$, $m\angle DBC = 45$, and $S = 30$ feet, what is the height of the cliff, to the *nearest foot*?

9. 080527b, P.I. A2.A.73

The accompanying diagram shows the plans for a cell-phone tower that is to be built near a busy highway. Find the height of the tower, to the *nearest foot.*

10. 080233b, P.I. A2.A.73

Carmen and Jamal are standing 5,280 feet apart on a straight, horizontal road. They observe a hot-air balloon between them directly above the road. The angle of elevation from Carmen is 60° and from Jamal is 75°. Draw a diagram to illustrate this situation and find the height of the balloon to the *nearest foot.*
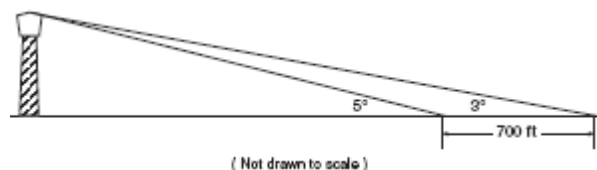
11. 010334b, P.I. A2.A.73
A ship captain at sea uses a sextant to sight an angle of elevation of 37° to the top of a lighthouse. After the ship travels 250 feet directly toward the lighthouse, another sighting is made, and the new angle of elevation is 50°. The ship's charts show that there are dangerous rocks 100 feet from the base of the lighthouse. Find, to the *nearest foot*, how close to the rocks the ship is at the time of the second sighting.

12. 060332b, P.I. A2.A.73
While sailing a boat offshore, Donna sees a lighthouse and calculates that the angle of elevation to the top of the lighthouse is 3°, as shown in the accompanying diagram. When she sails her boat 700 feet closer to the lighthouse, she finds that the angle of elevation is now 5°. How tall, to the *nearest tenth of a foot*, is the lighthouse?

5°   3°

─── 700 ft ───

(Not drawn to scale)

13. 010534b, P.I. A2.A.73
A sign 46 feet high is placed on top of an office building. From a point on the sidewalk level with the base of the building, the angle of elevation to the top of the sign and the angle of elevation to the bottom of the sign are 40° and 32°, respectively. Sketch a diagram to represent the building, the sign, and the two angles, and find the height of the building to the *nearest foot.*

14. 010212b, P.I. A2.A.73
In $\triangle ABC$, $m\angle A = 33$, $a = 12$, and $b = 15$. What is $m\angle B$ to the *nearest degree*?

[A] 41   [B] 48   [C] 43   [D] 44

15. 010407b, P.I. A2.A.73
In $\triangle ABC$, $a = 19$, $c = 10$, and $m\angle A = 111$. Which statement can be used to find the value of $\angle C$?

[A] $\sin C = \dfrac{19\sin 69°}{10}$
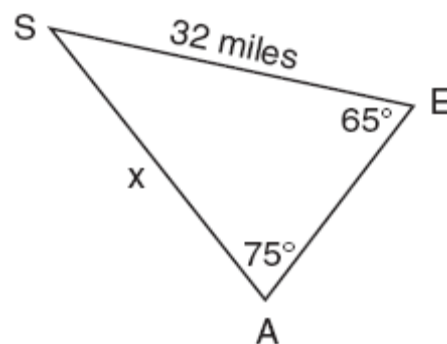
[B] $\sin C = \dfrac{10\sin 69°}{19}$

[C] $\sin C = \dfrac{10}{19}$ [D] $\sin C = \dfrac{10\sin 21°}{19}$

16. 060922b, P.I. A2.A.73
In $\triangle ABC$, $\sin A = 0.6$, $a = 10$, and $b = 7$. Find $\sin B$.

17. 010702b, P.I. A2.A.73
The accompanying diagram shows the approximate linear distances traveled by a sailboat during a race. The sailboat started at point *S*, traveled to points *E* and *A*, respectively, and ended at point *S*.

S   32 miles
                              65° E
      x
              75°
          A

Based on the measures shown in the diagram, which equation can be used to find *x*, the distance from point *A* to point *S*?

[A] $\dfrac{x}{65} = \dfrac{32}{75}$ [B] $\dfrac{65}{x} = \dfrac{32}{75}$

[C] $\dfrac{x}{\sin 65°} = \dfrac{\sin 75°}{32}$

[D] $\dfrac{\sin 65°}{x} = \dfrac{\sin 75°}{32}$

A2.A.73: Solve for an unknown side or angle, using the Law of Sines or the Law of Cosines

[1] C_____

[4] $BC = 6.75$ and the area of $\triangle ABC = 16.7055$ or 16.71 or an equivalent answer, and appropriate work is shown, such as using the Law of Sines and the formula for the area of a triangle.
[3] Appropriate work is shown, but one computational error is made.
[2] Only the correct length of $\overline{BC}$ is found, and appropriate work is shown.
or [2] The length of $\overline{BC}$ is found incorrectly, but an appropriate area of the triangle is found, based on the incorrect value of $\overline{BC}$.
[1] The Law of Sines is used, and appropriate substitution is made, but no further work is shown.
or [1] $BC = 6.75$ and the area of $\triangle ABC = 16.7055$ or 16.71 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 incorrect procedure.

[2]

[2] 1.15, and appropriate work is shown, such as $\dfrac{x}{\sin 130} = \dfrac{0.75}{\sin 30}$.
[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] 1.15, 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.

[3]

[4] 234, and appropriate work is shown, such as using the Law of Sines.
[3] Appropriate work is shown, but one computational or rounding error is made.
or [3] Appropriate work is shown, but one substitution error is made, such as using 42 as $m\angle FAB$.
or [3] Appropriate work is shown, but the correct distance to station B (180 miles) 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.
or [2] Correct substitution is made into the Law of Sines, but no further correct work is shown.
[1] Appropriate work is shown, but one conceptual error and one computational error are made.
or [1] 234, 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] _____

[2] 3, and appropriate work is shown, such as $\dfrac{10}{\sin 53°} = \dfrac{b}{\sin 14°}$.
[1] Appropriate work is shown, but one computational or rounding error is made.
or [1] The proportion $\dfrac{10}{\sin 53°} = \dfrac{b}{\sin 14°}$ is written, but no further correct work is shown.
or [1] An incorrect proportion of equal difficulty is solved appropriately.
or [1] 3, 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.

[5] _____

[4] 438, and appropriate work is shown, such as using the Law of Cosines or the Law of Sines.
[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 or the Law of Sines, 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] 438, but no work is shown.
[0] Right triangle trigonometry is used inappropriately.
or [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an

[6] obviously incorrect procedure.

[4] 12, and appropriate work is shown, such as using the Law of Sines twice or the Law of Sines and 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.
[1] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.
or [1] 12, but no work is shown.
[0] The Pythagorean theorem is used to solve the problem.
or [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an

[7] obviously incorrect procedure.

[4] 41, and appropriate work is shown.
[3] Appropriate work is shown, but one computational or rounding error is made.
[2] One incorrect formula is used, but an appropriate answer is found.
or [2] Appropriate work is shown, but one computational and one rounding error are made.
[1] 41, 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] 88, and appropriate work is shown, such $\dfrac{y}{\sin 32} = \dfrac{100}{\sin 33}$ and $\sin 65 = \dfrac{x}{y}$.
[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, such as setting up an incorrect proportion.
or [2] The hypotenuse of one of the right triangles is found correctly, 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] The obtuse triangle is treated as a right triangle, but an appropriate height is found for the tower.
or [1] 88, 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.

[6] 6,246 and a correct diagram is drawn, and appropriate work is shown, such as the use of the Law of Sines twice or the Law of Sines followed by right triangle trigonometry or another valid method.
[5] Appropriate work is shown, but one computational or rounding error is made.
[4] One of the two unknown sides of the triangle is calculated correctly and appropriate work is shown, but an incorrect method is used for calculating the altitude.
[3] A correct diagram is drawn, and the Law of Sines is used, but one computational or rounding error is made, and the altitude is not found.
[2] 6,246 and a correct diagram is drawn, but no further work is shown.
or [2] A correct diagram is drawn, but the assumption is made that the altitude bisects the base, and an appropriate altitude is found.
[1] Only a correct diagram is drawn, and no further correct work is shown.
or [1] 6,246, 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.

[6] 330, and appropriate work is shown, such as solving $\dfrac{\sin 13}{250} = \dfrac{\sin 37}{y}$ and calculating $\cos 50 = \dfrac{x}{668.8288536}$ and subtracting 100.
[5] Appropriate work is shown, but one computational or rounding error is made.
or [5] Appropriate work is shown, but 100 is not subtracted from the answer.
or [5] An incorrect trigonometric function is used, but the rest of the work is appropriate.
[4] The Law of Sines is used incorrectly, such as using the wrong angle measure, but an appropriate distance from the rocks is found.
[3] The Law of Sines is used correctly, but no answer or an incorrect answer is found.
[2] The Law of Sines is used without finding the angles correctly, and no answer or an incorrect answer is found.
[1] Only a correct diagram is drawn.
or [1] 330, 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] 91.5, and appropriate work is shown, such as using the Law of Sines to find either side of the obtuse triangle and then using the sine function to find the height of the lighthouse.
[3] Appropriate work is shown, but one computational or rounding error is made.
or [3] The angles in the obtuse triangle are found incorrectly, but appropriate work is shown, and an appropriate height of the lighthouse is found.
[2] Appropriate work is shown, but more than one computational or rounding error is made.
or [2] A correct length of a side of the obtuse triangle is found, but no further correct work is shown.
[1] An appropriate equation is set up for one triangle, but it is not solved.
or [1] 91.5, 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

[12]   incorrect procedure.

[6] A correct diagram is drawn and 134, and appropriate work is shown.
[5] Appropriate work is shown, but one computational or rounding error is made.
or [5] 134, and appropriate work is shown, but the diagram is not drawn or is drawn incorrectly.
[4] Appropriate work is shown, but two or more computational or rounding errors are made.
or [4] A correct diagram is drawn and one correct equation using the Law of Sines is solved appropriately, but no further correct work is shown.
[3] Appropriate work is shown, but one conceptual error is made.
or [3] An incorrect diagram is drawn, but an appropriate solution with an equal degree of difficulty is provided.
or [3] A correct diagram is drawn and correct equations are written, but no further correct work is shown.
[2] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.
or [2] A correct diagram is drawn, but only one correct trigonometric equation is written, and no further correct work is shown.
[1] A correct diagram is drawn, but no further correct work is shown.
or [1] An incorrect diagram is drawn, but one correct trigonometric equation is solved appropriately.
or [1] 134, 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

[13]   incorrect procedure.

[14]   C

[15]   B

[2] 0.42, and appropriate work is shown.
[1] Appropriate work is shown, but one computational error is made.
or [1] Appropriate work is shown, but one conceptual error is made.
or [1] A correct equation is written, but $\sin B$ is not found.
or [1] 0.42, 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
[16] incorrect procedure.

[17] D