CHAPTER 9-2

UNIT CIRCLE

1. 080417b
Which angle is coterminal with an angle of 125°?

[A] -235° [B] 235°

[C] 425° [D] -125°

[1] _____

2. 060503b, P.I. A2.A.57
Expressed as a function of a positive acute angle, sin (-230°) is equal to

[A] sin 50° [B] -sin 50°

[C] cos 50° [D] -cos 50°

[2] _____

3. 010818b, P.I. A2.A.57
The expression $\cos(\pi - x)$ is equivalent to

[A] cos *x* [B] -cos *x*

[C] -sin *x* [D] sin *x*

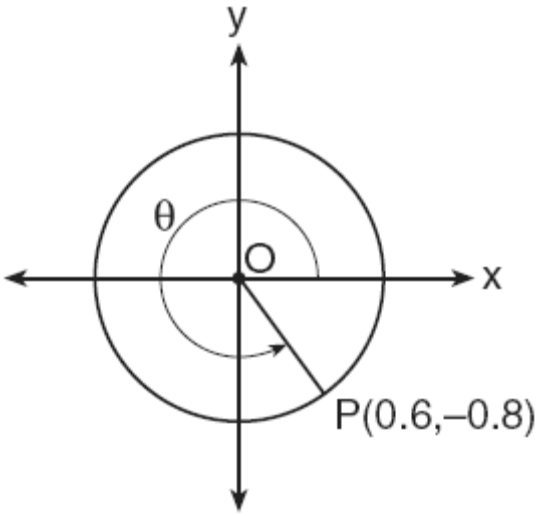
[3] _____

4. 010205b, P.I. A2.A.56
If θ is an angle in standard position and its terminal side passes through the point $(\frac{1}{2}, \frac{\sqrt{3}}{2})$ on a unit circle, a possible value of θ is

[A] 120° [B] 60° [C] 30° [D] 150°

[4] _____

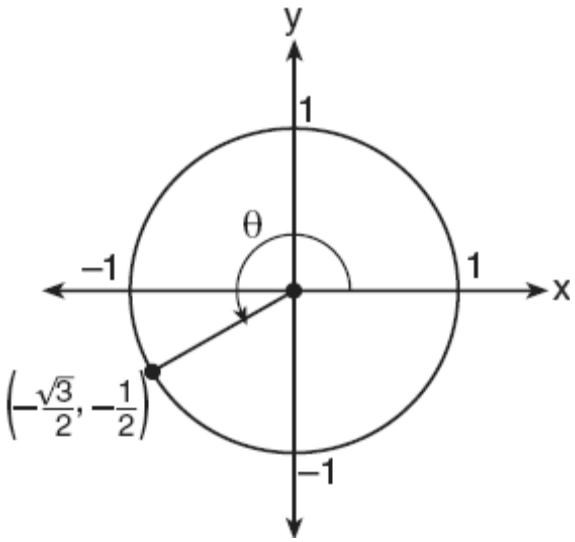
5. 010422b, P.I. A2.A.62
In the accompanying diagram, point $P(0.6,-0.8)$ is on unit circle *O*. What is the value of θ, to the *nearest degree*?



[5] _____

6. 080510b, P.I. A2.A.62

In the accompanying diagram of a unit circle, the ordered pair $(-\frac{\sqrt{3}}{2},-\frac{1}{2})$ represents the point where the terminal side of θ intersects the unit circle.



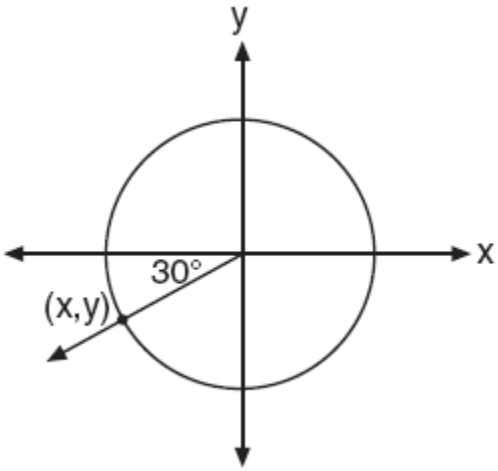
What is $m\angle\theta$?

[A] 233 [B] 225 [C] 240 [D] 210

[6] _____

7. 010718b

In the unit circle shown in the accompanying diagram, what are the coordinates of (x, y)?



[A] $(-\frac{\sqrt{3}}{2},-0.5)$ [B] $(-30,-210)$

[C] $(-0.5,-\frac{\sqrt{3}}{2})$ [D] $(-\frac{\sqrt{2}}{2},-\frac{\sqrt{2}}{2})$

[7] _____

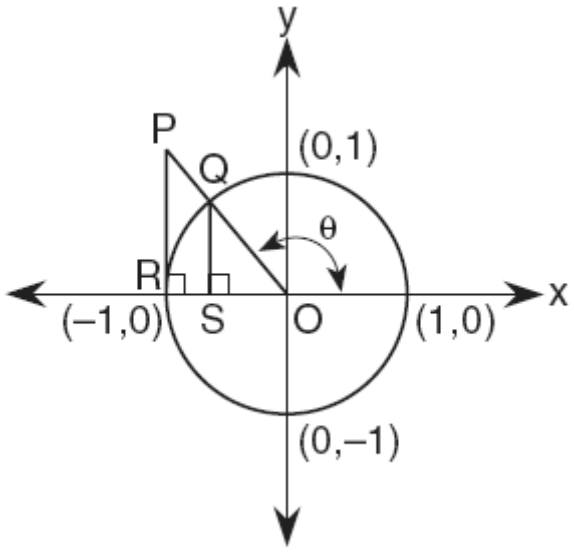
8. 080121b, P.I. A2.A.67

If the sine of an angle is $\frac{3}{5}$ and the angle is *not* in Quadrant I, what is the value of the cosine of the angle?

[8] _____

9. 060520b

In the accompanying diagram, $\overline{PR}$ is tangent to circle O at R, $\overline{QS} \perp \overline{OR}$, and $\overline{PR} \perp \overline{OR}$.



Which measure represents $\sin\theta$?

[A] RO [B] QS [C] PR [D] SO

[9] _____

10. 080604b, P.I. A2.A.67

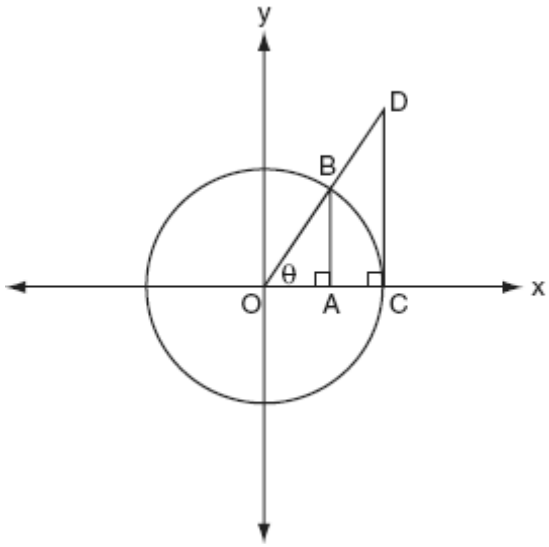
If x is a positive acute angle and $\cos x = \frac{\sqrt{3}}{4}$, what is the exact value of $\sin x$?

[A] $\frac{3}{5}$ [B] $\frac{\sqrt{13}}{4}$ [C] $\frac{4}{5}$ [D] $\frac{\sqrt{3}}{5}$

[10] _____

11. 080618b

The accompanying diagram shows unit circle O, with radius $OB = 1$.



Which line segment has a length equivalent to $\cos\theta$?

[A] $\overline{OC}$ [B] $\overline{AB}$ [C] $\overline{CD}$ [D] $\overline{OA}$

[11] _____

12. 080511b

Two straight roads intersect at an angle whose measure is 125°. Which expression is equivalent to the cosine of this angle?

[A] -cos 55° [B] -cos 35°

[C] cos 55° [D] cos 35°

[12] _____

13. 010616b, P.I. A2.A.62

If θ is an angle in standard position and $P(-3,4)$ is a point on the terminal side of θ, what is the value of $\sin\theta$?

[A] $\frac{4}{5}$ [B] $-\frac{3}{5}$ [C] $-\frac{4}{5}$ [D] $\frac{3}{5}$

[13] _____

14. 060302b, P.I. A2.A.58
If $\sin\theta > 0$ and $\sec\theta < 0$, in which quadrant does the terminal side of angle θ lie?

[A] IV [B] II [C] III [D] I

[14] _____

15. 080410b, P.I. A2.A.58
If the tangent of an angle is negative and its secant is positive, in which quadrant does the angle terminate?

[A] III [B] IV [C] II [D] I

[15] _____

16. 060502b
If $\sin\theta$ is negative and $\cos\theta$ is negative, in which quadrant does the terminal side of θ lie?

[A] IV [B] III [C] II [D] I

[16] _____

17. 060609b, P.I. A2.A.58
If $\tan\theta = 2.7$ and $\csc\theta < 0$, in which quadrant does θ lie?

[A] IV [B] III [C] II [D] I

[17] _____

18. 060118b
If θ is an obtuse angle and $\sin\theta = b$, then it can be concluded that

[A] $\cos 2\theta > b$ [B] $\sin 2\theta < b$

[C] $\cos\theta > b$ [D] $\tan\theta > b$

[18] _____

19. 060222b, P.I. A2.A.66
Is $\frac{1}{2}\sin 2x$ the same expression as $\sin x$?
Justify your answer.

[19] _____

CHAPTER 9-3

RADIAN MEASURE

20. 080623b, P.I. A2.M.2
What is the number of degrees in an angle whose radian measure is $\frac{7\pi}{12}$?

[20] _____

21. 080704b, P.I. A2.M.2
What is $235°$, expressed in radian measure?

[A] $\frac{\pi}{235}$ [B] $\frac{47\pi}{36}$

[C] 235π [D] $\frac{36\pi}{47}$

[21] _____

22. 060120b
Through how many radians does the minute hand of a clock turn in 24 minutes?

[A] 0.6π [B] 0.2π

[C] 0.4π [D] 0.8π

[22] _____

23. 010615b
What is the radian measure of the angle formed by the hands of a clock at 2:00 p.m.?

[A] $\frac{\pi}{2}$ [B] $\frac{\pi}{4}$ [C] $\frac{\pi}{6}$ [D] $\frac{\pi}{3}$

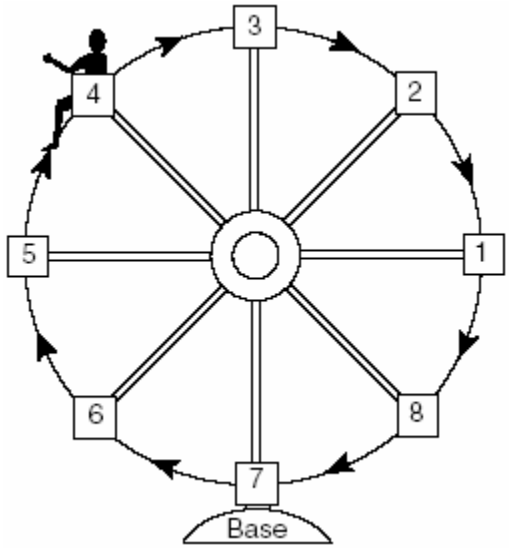
[23] _____

24. 080223b
An art student wants to make a string collage by connecting six equally spaced points on the circumference of a circle to its center with string. What would be the radian measure of the angle between two adjacent pieces of string, in simplest form?

[24] _____

25. 010421b

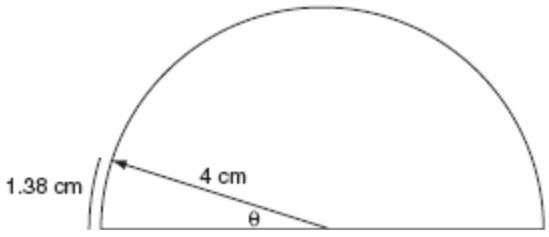
Kristine is riding in car 4 of the Ferris wheel represented in the accompanying diagram. The Ferris wheel is rotating in the direction indicated by the arrows. The eight cars are equally spaced around the circular wheel. Express, in radians, the measure of the *smallest* angle through which she will travel to reach the bottom of the Ferris wheel.



[25] _____

26. 010725b

As shown in the accompanying diagram, a dial in the shape of a semicircle has a radius of 4 centimeters. Find the measure of θ, in radians, when the pointer rotates to form an arc whose length is 1.38 centimeters.



[26] _____

27. 080116b

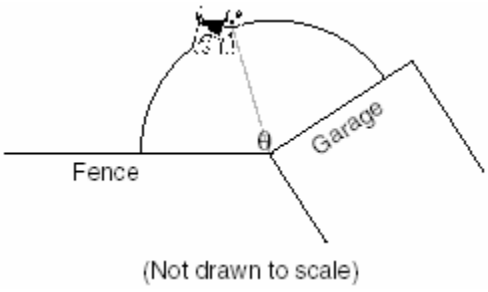
A wedge-shaped piece is cut from a circular pizza. The radius of the pizza is 6 inches. The rounded edge of the crust of the piece measures 4.2 inches. To the *nearest tenth*, the angle of the pointed end of the piece of pizza, in radians, is

[A] 1.4 [B] 0.7 [C] 7.0 [D] 25.2

[27] _____

28. 080309b

A dog has a 20-foot leash attached to the corner where a garage and a fence meet, as shown in the accompanying diagram. When the dog pulls the leash tight and walks from the fence to the garage, the arc the leash makes is 55.8 feet.

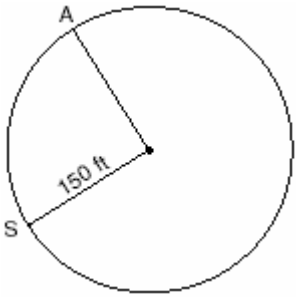


What is the measure of angle θ between the garage and the fence, in radians?

[A] 160 [B] 3.14 [C] 2.79 [D] 0.36

[28] _____

29. 060531b, P.I. A2.A.61
Kathy and Tami are at point *A* on a circular track that has a radius of 150 feet, as shown in the accompanying diagram. They run counterclockwise along the track from *A* to *S*, a distance of 247 feet. Find, to the *nearest degree*, the measure of minor arc *AS*.



[29] _____

30. 010526b, P.I. A2.A.56
An arc of a circle that is 6 centimeters in length intercepts a central angle of 1.5 radians. Find the number of centimeters in the radius of the circle.

[30] _____

31. 060626b
The pendulum of a clock swings through an angle of 2.5 radians as its tip travels through an arc of 50 centimeters. Find the length of the pendulum, in centimeters.

[31] _____

32. 010307b
Ileana buys a large circular pizza that is divided into eight equal slices. She measures along the outer edge of the crust from one piece and finds it to be $5\frac{1}{2}$ inches. What is the diameter of the pizza to the *nearest inch*?

[A] 7 [B] 4 [C] 14 [D] 8

[32] _____

33. 010806b
Jack wants to plant a border of flowers in the shape of an arc along the edge of a circular walkway. If the circle has a radius of 5 yards and the angle subtended by the arc measures $1\frac{1}{2}$ radians, what is the length, in yards, of the border?

[A] 2 [B] 7.5 [C] 5 [D] 0.5

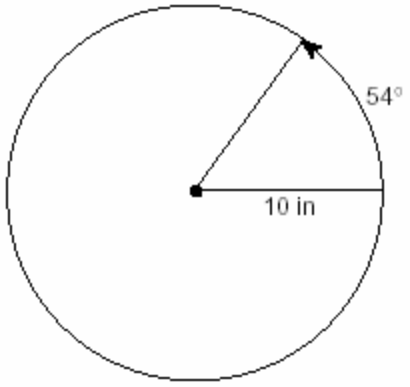
[33] _____

34. 080109b
A regular hexagon is inscribed in a circle. What is the ratio of the length of a side of the hexagon to the minor arc that it intercepts?

[A] $\frac{3}{6}$ [B] $\frac{3}{\pi}$ [C] $\frac{6}{\pi}$ [D] $\frac{\pi}{6}$

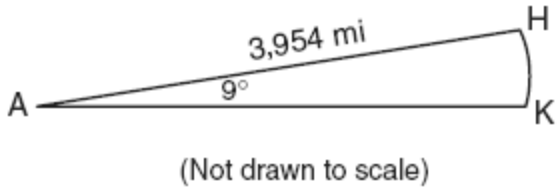
[34] _____

35. 010223b, P.I. A2.A.61
A ball is rolling in a circular path that has a radius of 10 inches, as shown in the accompanying diagram. What distance has the ball rolled when the subtended arc is 54°? Express your answer to the *nearest hundredth of an inch.*



[35] _____

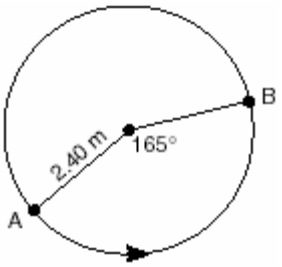
36. 080426b, P.I. A2.A.61
Cities *H* and *K* are located on the same line of longitude and the difference in the latitude of these cities is 9°, as shown in the accompanying diagram. If Earth's radius is 3,954 miles, how many miles north of city *K* is city *H* along arc *HK*? Round your answer to the *nearest tenth of a mile*.



(Not drawn to scale)

[36] _____

37. 080524b, P.I. A2.A.61
The accompanying diagram shows the path of a cart traveling on a circular track of radius 2.40 meters. The cart starts at point *A* and stops at point *B*, moving in a counterclockwise direction. What is the length of minor arc *AB*, over which the cart traveled, to the *nearest tenth of a meter*?



[37] _____

CHAPTER 9-4

TRIGONOMETRIC GRAPHS

38. 080113b, P.I. A2.A.69
What is the period of the function $y = 5\sin 3x$?

[A] $\frac{2\pi}{3}$ [B] $\frac{2\pi}{5}$ [C] 3 [D] 5

[38] _____

39. 080615b, P.I. A2.A.69
What is the period of the graph of the equation $y = 2\sin\frac{1}{3}x$?

[A] 6π [B] $\frac{2}{3}\pi$ [C] $\frac{3\pi}{2}$ [D] 2π

[39] _____

40. 010810b, P.I. A2.A.69
A wave displayed by an oscilloscope is represented by the equation $y = 3\sin x$. What is the period of this function?

[A] 3π [B] 2π [C] 2 [D] 3

[40] _____

41. 010606b, P.I. A2.A.69
A sound wave is modeled by the curve $y = 3\sin 4x$. What is the period of this curve?

[A] 4 [B] π [C] $\frac{\pi}{2}$ [D] 3

[41] _____

42. 080514b, P.I. A2.A.69
A certain radio wave travels in a path represented by the equation $y = 5\sin 2x$. What is the period of this wave?

[A] π [B] 2π [C] 5 [D] 2

[42] _____

43. 060105b, P.I. A2.A.69
A modulated laser heats a diamond. Its variable temperature, in degrees Celsius, is given by $f(t) = T\sin at$. What is the period of the curve?

[A] $|T|$ [B] $\frac{2a\pi}{a}$ [C] $\frac{1}{a}$ [D] $\frac{2\pi}{a}$

[43] _____

44. 010425b, P.I. A2.A.69
The brightness of the star MIRA over time is given by the equation $y = 2 \sin \frac{\pi}{4}x + 6$, where x represents time and y represents brightness. What is the period of this function, in radian measure?

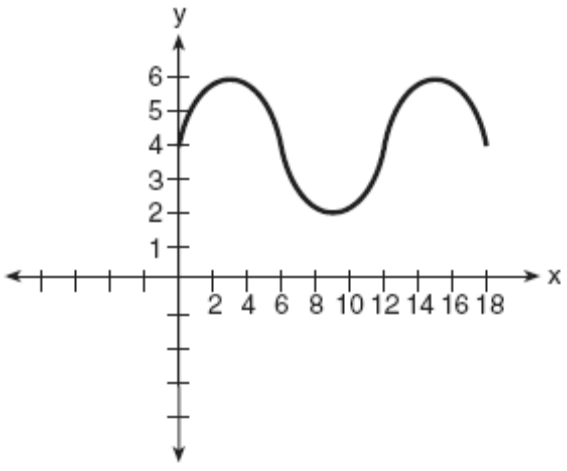
[44] _____

45. 010204b, P.I. A2.A.69
An object that weighs 2 pounds is suspended in a liquid. When the object is depressed 3 feet from its equilibrium point, it will oscillate according to the formula $x = 3\cos(8t)$, where t is the number of seconds after the object is released. How many seconds are in the period of oscillation?

[A] 2π [B] π [C] $\frac{\pi}{4}$ [D] 3

[45] _____

46. 010715b, P.I. A2.A.69
What is the amplitude of the function shown in the accompanying graph?



[A] 2 [B] 12 [C] 1.5 [D] 6

[46] _____

47. 060403b, P.I. A2.A.69
What is the amplitude of the function $y = \frac{2}{3}\sin 4x$?

[A] $\frac{2}{3}$ [B] 4 [C] 3π [D] $\frac{\pi}{2}$

[47] _____

48. 010301b, P.I. A2.A.69
A monitor displays the graph $y = 3\sin 5x$. What will be the amplitude after a dilation of 2?

[A] 5 [B] 7 [C] 6 [D] 10

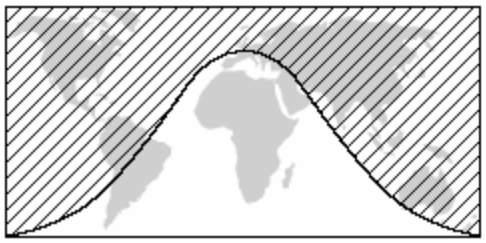
[48] _____

49. 080419b
The path traveled by a roller coaster is modeled by the equation $y = 27\sin 13x + 30$. What is the maximum altitude of the roller coaster?

[A] 57 [B] 30 [C] 27 [D] 13

[49] _____

50. 010502b
The shaded portion of the accompanying map indicates areas of night, and the unshaded portion indicates areas of daylight at a particular moment in time.



Which type of function best represents the curve that divides the area of night from the area of daylight?

[A] tangent [B] cosine

[C] logarithmic [D] quadratic

[50] _____

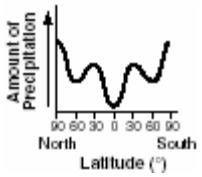
51. 010711b
Which transformation could be used to make the graph of the equation $y = \sin x$ coincide with the graph of the equation $y = \cos x$?

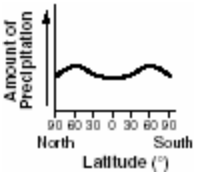
[A] point reflection [B] translation

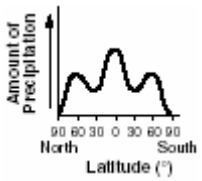
[C] dilation [D] rotation

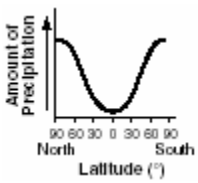
[51] _____

52. 080503b
The graphs below show the average annual precipitation received at different latitudes on Earth. Which graph is a translated cosine curve?

[A]


[B]


[C]


[D]


[52] _____

53. 010216b
Which type of symmetry does the equation $y = \cos x$ have?

[A] point symmetry with respect to $(\frac{\pi}{2},0)$

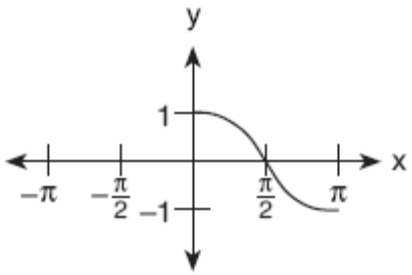
[B] line symmetry with respect to $y = x$

[C] point symmetry with respect to the origin

[D] line symmetry with respect to the x-axis

[53] _____

54. 060711b, P.I. A2.A.72
Which equation is represented by the accompanying graph?

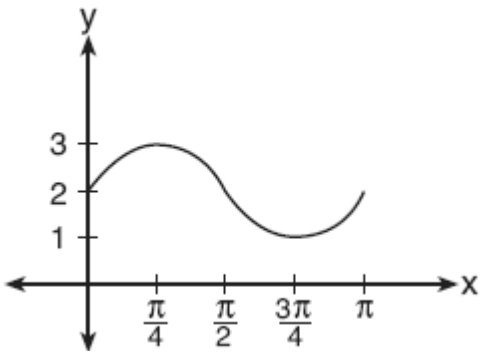


[A] $y = \cos x$ [B] $y = \cos 2x$

[C] $y = \frac{1}{2}\cos x$ [D] $y = \cos\frac{1}{2}x$

[54] _____

55. 080717b, P.I. A2.A.72
The accompanying graph represents a portion of a sound wave.



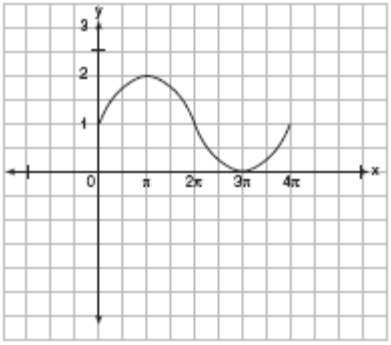
Which equation best represents this graph?

[A] $y = \sin 2x + 2$ [B] $y = \sin\frac{1}{2}x + 2$

[C] $y = \sin 2x$ [D] $y = 2\sin\frac{1}{2}x$

[55] _____

56. 010612b, P.I. A2.A.72
In physics class, Eva noticed the pattern shown in the accompanying diagram on an oscilloscope.



Which equation best represents the pattern shown on this oscilloscope?

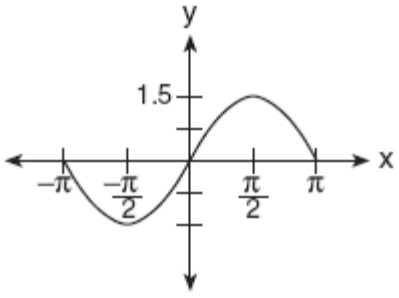
[A] $y = \sin(\frac{1}{2}x) + 1$

[B] $y = 2\sin x + 1$ [C] $y = \sin x + 1$

[D] $y = 2\sin(-\frac{1}{2}x) + 1$

[56] _____

57. 060608b, P.I. A2.A.72
A radio transmitter sends a radio wave from the top of a 50-foot tower. The wave is represented by the accompanying graph.



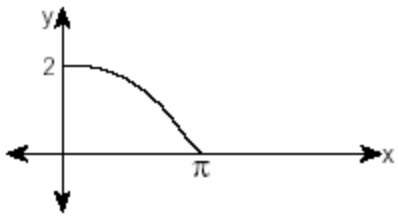
What is the equation of this radio wave?

[A] $y = 1.5\sin x$ [B] $y = \sin 1.5x$

[C] $y = \sin x$ [D] $y = 2\sin x$

[57] _____

58. 010214b, P.I. A2.A.72
The accompanying diagram shows a section of a sound wave as displayed on an oscilloscope.



Which equation could represent this graph?

[A] $y = 2\sin\frac{x}{2}$ [B] $y = 2\cos\frac{x}{2}$

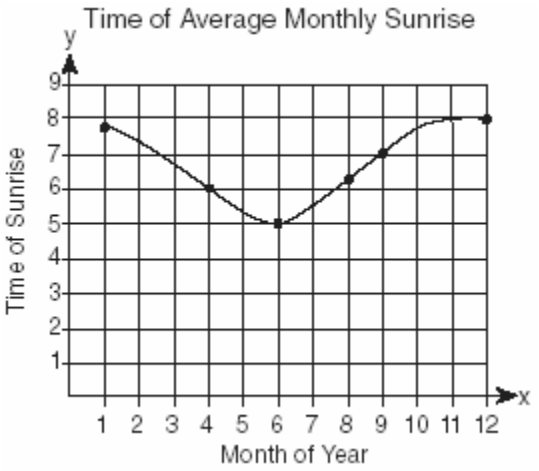
[C] $y = \frac{1}{2}\sin\frac{\pi}{2}x$ [D] $y = \frac{1}{2}\cos 2x$

[58] _____

59. 080330b, P.I. A2.A.72
A student attaches one end of a rope to a wall at a fixed point 3 feet above the ground, as shown in the accompanying diagram, and moves the other end of the rope up and down, producing a wave described by the equation $y = a\sin bx + c$. The range of the rope's height above the ground is between 1 and 5 feet. The period of the wave is 4π. Write the equation that represents this wave.

[59] _____

60. 080127b
The times of average monthly sunrise, as shown in the accompanying diagram, over the course of a 12-month interval can be modeled by the equation $y = A\cos(Bx) + D$.
Determine the values of *A*, *B*, and *D*, and explain how you arrived at your values.

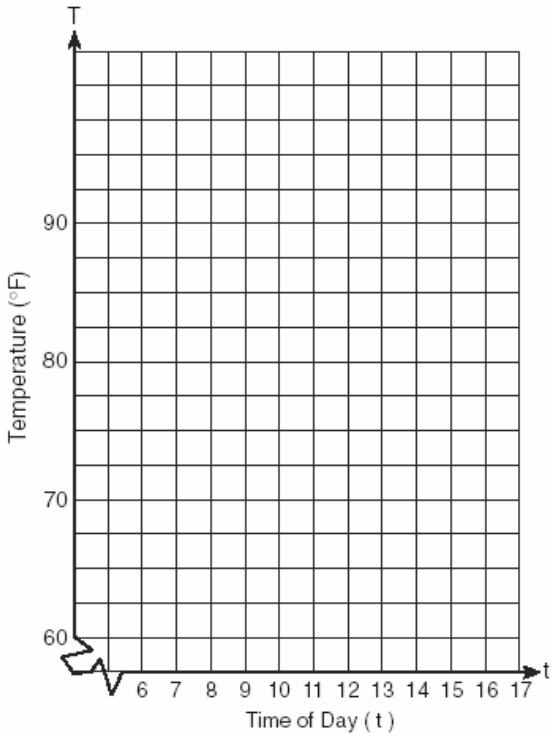


[60] _____

CHAPTER 9-5

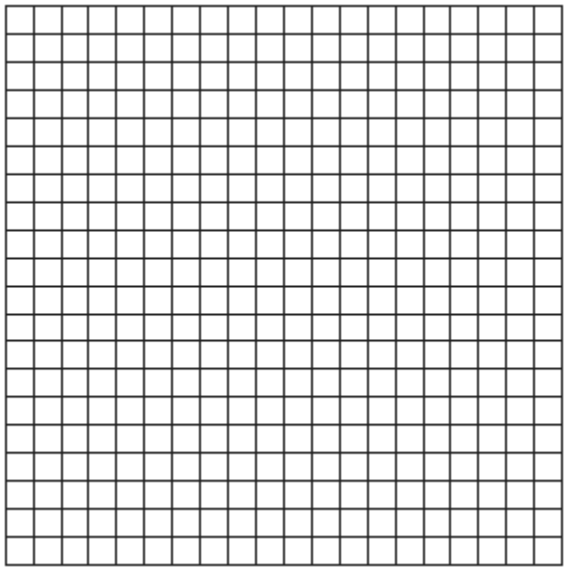
TRIGONOMETRIC INEQUALITIES

61. 010329b
A building's temperature, *T*, varies with time of day, *t*, during the course of 1 day, as follows: $T = 8\cos t + 78$. The air-conditioning operates when $T \geq 80° F$. Graph this function for $6 \leq t < 17$ and determine, to the *nearest tenth of an hour*, the amount of time in 1 day that the air-conditioning is on in the building.



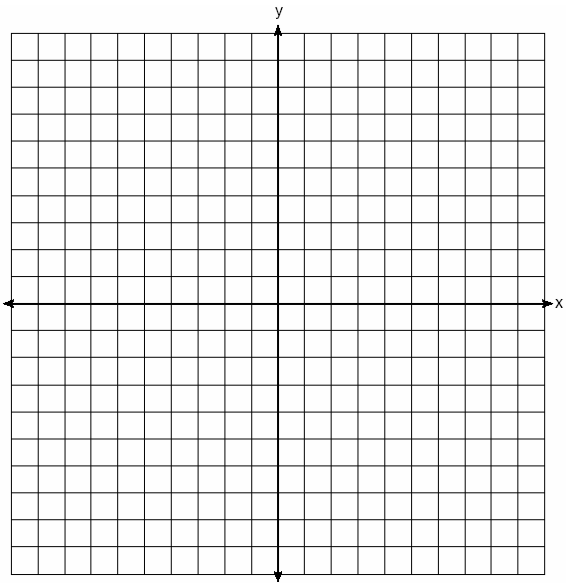
[61] _____

62. 080433b
The tide at a boat dock can be modeled by the equation $y = -2\cos(\frac{\pi}{6}t) + 8$, where *t* is the number of hours past noon and *y* is the height of the tide, in feet. For how many hours between *t* = 0 and *t* = 12 is the tide at least 7 feet? [The use of the grid is optional.]



[62] _____

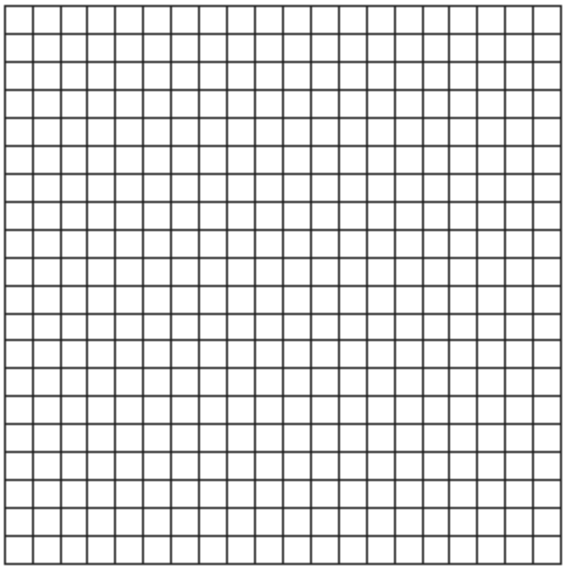
63. 080532b, P.I. A2.A.70
On the accompanying set of axes, graph the equations $y = 4\cos x$ and $y = 2$ in the domain $-\pi \le x \le \pi$. Express, in terms of π, the interval for which $4\cos x \ge 2$.



[63] _____

SOLVING NONLINEAR SYSTEMS

64. 060329b
A pair of figure skaters graphed part of their routine on a grid. The male skater's path is represented by the equation $m(x) = 3\sin\frac{1}{2}x$, and the female skater's path is represented by the equation $f(x) = -2\cos x$. On the accompanying grid, sketch both paths and state how many times the paths of the skaters intersect between $x = 0$ and $x = 4\pi$.



[64] _____

65. 060233b
On a monitor, the graphs of two impulses are recorded on the same screen, where $0° \le x < 360°$. The impulses are given by the following equations:

$$y = 2\sin^2 x$$

$$y = 1 - \sin x$$

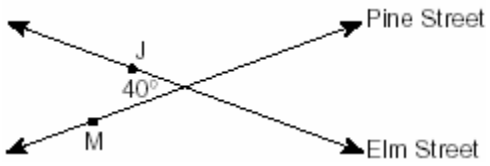
Find all values of x, in degrees, for which the two impulses meet in the interval $0° \le x < 360°$. [Only an algebraic solution will be accepted.]

[65] _____

CHAPTER 9-7

LAW OF COSINES

66. 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.



[66] _____

67. 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.*

[67] _____

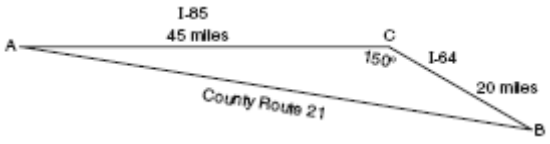
68. 010528b, P.I. A2.A.73
To measure the distance through a mountain for a proposed tunnel, surveyors chose points *A* and *B* at each end of the proposed tunnel and a point *C* near the mountain. They determined that *AC* = 3,800 meters, *BC* = 2,900 meters, and $m\angle ACB = 110$. Draw a diagram to illustrate this situation and find the length of the tunnel, to the *nearest meter*.

[68] _____

69. 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.*

[69] _____

70. 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?



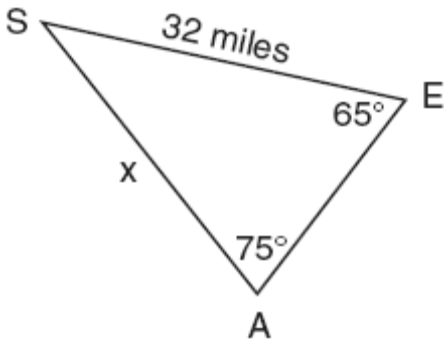
[70] _____

71. 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*?

[71] _____

LAW OF SINES

72. 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*.



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] $\frac{65}{x}=\frac{32}{75}$ [B] $\frac{\sin 65°}{x}=\frac{\sin 75°}{32}$

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

[72] _____

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

[A] $\sin C=\frac{19\sin 69°}{10}$

[B] $\sin C=\frac{10\sin 69°}{19}$

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

[73] _____

74. 060622b, P.I. A2.A.73
In ΔABC, $m\angle A=53$, $m\angle B=14$, and $a=10$. Find *b* to the *nearest integer*.

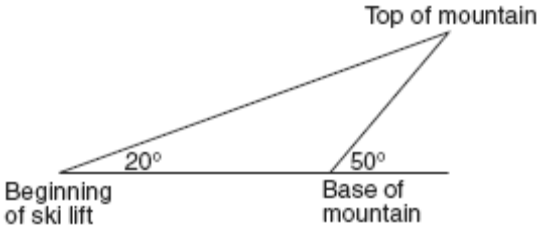
[74] _____

75. 010212b, P.I. A2.A.73
In ΔABC, $m\angle A=33$, $a=12$, and $b=15$. What is $m\angle B$ to the *nearest degree*?

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

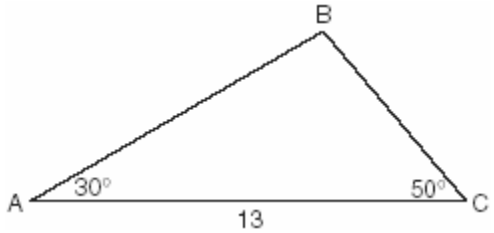
[75] _____

76. 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.*



[76] _____

77. 080214b, P.I. A2.A.73
In the accompanying diagram of ΔABC, $m\angle A = 30$, $m\angle C = 50$, and $AC = 13$.

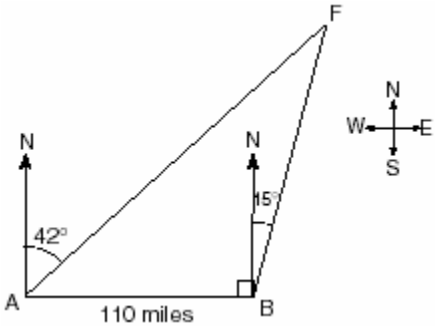


What is the length of side $\overline{AB}$ to the *nearest tenth*?

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

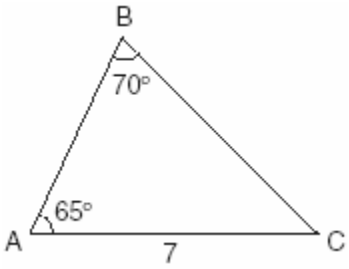
[77] _____

78. 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*?



[78] _____

79. 080131b, P.I. A2.A.73
In the accompanying diagram of ΔABC, $m\angle A = 65$, $m\angle B = 70$, and the side opposite vertex *B* is 7. Find the length of the side opposite vertex *A*, and find the area of ΔABC.



[79] _____

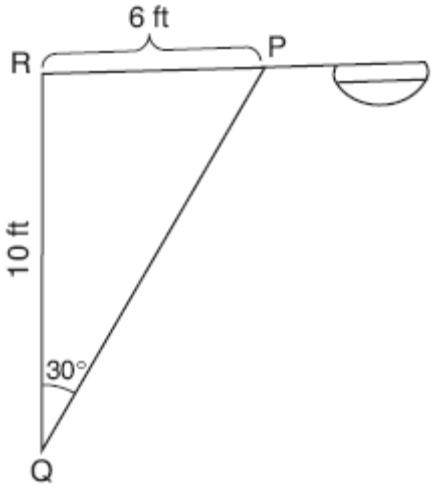
80. 010631b, P.I. A2.A.73
The Vietnam Veterans Memorial in Washington, D.C., is made up of two walls, each 246.75 feet long, that meet at an angle of 125.2°. Find, to the *nearest foot*, the distance between the ends of the walls that do not meet.

[80] _____

81. 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.*

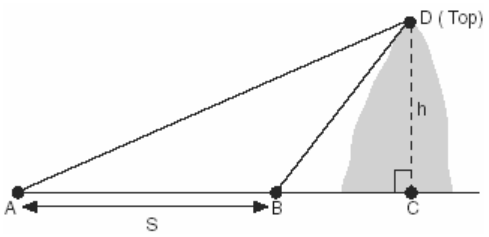
[81] _____

82. 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.*



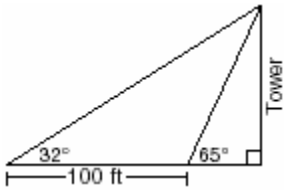
[82] _____

83. 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*?



[83] _____

84. 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.*

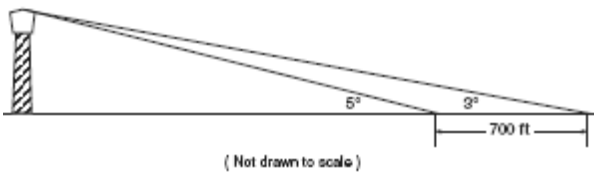


[84] _____

85. 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.

[85] _____

86. 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?



[86] _____

87. 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.*

[87] _____

MATH TOOLBOX P. 449

LAW OF SINES - THE AMBIGUOUS CASE

88. 080414b, P.I. A2.A.75
How many distinct triangles can be formed if $m\angle A = 30$, side $b = 12$, and side $a = 8$?

[A] 0 [B] 3 [C] 2 [D] 1

[88] _____

89. 080519b, P.I. A2.A.75
What is the total number of distinct triangles that can be constructed if $AC = 13$, $BC = 8$, and $m\angle A = 36$?

[A] 3 [B] 2 [C] 0 [D] 1

[89] _____

90. 080311b, P.I. A2.A.75
An architect commissions a contractor to produce a triangular window. The architect describes the window as ΔABC, where $m\angle A = 50$, $BC = 10$ inches, and $AB = 12$ inches. How many distinct triangles can the contractor construct using these dimensions?

[A] 1 [B] 0 [C] more than 2 [D] 2

[90] _____

91. 060416b, P.I. A2.A.75
Sam is designing a triangular piece for a metal sculpture. He tells Martha that two of the sides of the piece are 40 inches and 15 inches, and the angle opposite the 40-inch side measures 120°. Martha decides to sketch the piece that Sam described. How many different triangles can she sketch that match Sam's description?

[A] 2 [B] 1 [C] 3 [D] 0

[91] _____

92. 060620b, P.I. A2.A.75
Sam needs to cut a triangle out of a sheet of paper. The only requirements that Sam must follow are that one of the angles must be 60°, the side opposite the 60° angle must be 40 centimeters, and one of the other sides must be 15 centimeters. How many different triangles can Sam make?

[A] 3 [B] 1 [C] 2 [D] 0

[92] _____

93. 010426b, P.I. A2.A.75
A landscape designer is designing a triangular garden with two sides that are 4 feet and 6 feet, respectively. The angle opposite the 4-foot side is 30°. How many distinct triangular gardens can the designer make using these measurements?

[93] _____

94. 060119b, P.I. A2.A.75
Main Street and Central Avenue intersect, making an angle measuring 34°. Angela lives at the intersection of the two roads, and Caitlin lives on Central Avenue 10 miles from the intersection. If Leticia lives 7 miles from Caitlin, which conclusion is valid?

[A] Leticia cannot live on Main Street.

[B] Leticia can live at only one location on Main Street.

[C] Leticia can live at one of three locations on Main Street.

[D] Leticia can live at one of two locations on Main Street.

[94] _____

95. 010309b, P.I. A2.A.75
In ΔABC, if $AC = 12$, $BC = 11$, and $m\angle A = 30$, angle C could be

[A] a right angle, only

[B] an acute angle, only

[C] either an obtuse angle or an acute angle

[D] an obtuse angle, only

[95] _____

96. 010720b, P.I. A2.A.75
In ΔABC, $m\angle A = 30$, $a = 14$, and $b = 20$. Which type of angle is $\angle B$?

[A] It must be an acute angle.

[B] It may be either an acute angle or an obtuse angle.

[C] It must be a right angle.

[D] It must be an obtuse angle.

[96] _____

NY LESSONS 8 & 9

TRIGONOMETRIC IDENTITIES

97. 060610b, P.I. A2.A.67
The expression $\frac{1-\cos^2 x}{\sin^2 x}$ is equivalent to

[A] 1 [B] $\cos x$ [C] -1 [D] $\sin x$

[97] _____

98. 010608b, P.I. A2.A.67
The expression $(1 + \cos x)(1 - \cos x)$ is equivalent to

[A] 1 [B] $\csc^2 x$

[C] $\sin^2 x$ [D] $\sec^2 x$

[98] _____

99. 080526b, P.I. A2.A.67
Express in simplest terms: $\frac{2-2\sin^2 x}{\cos x}$

[99] _____

100. 080703b, P.I. A2.A.58
If $\csc\theta = -2$, what is the value of $\sin\theta$?

[A] -2 [B] 2 [C] $-\frac{1}{2}$ [D] $\frac{1}{2}$

[100] _____

101. 060720b, P.I. A2.A.67
The expression $\sin A + \frac{\cos^2 A}{\sin A}$ is equivalent to

[A] $\csc A$ [B] $\sec A$

[C] $\sin A$ [D] 1

[101] _____

102. 060418b, P.I. A2.A.67
If θ is a positive acute angle and $\sin\theta = a$, which expression represents $\cos\theta$ in terms of a?

[A] $\frac{1}{\sqrt{a}}$ [B] $\sqrt{1-a^2}$

[C] $\sqrt{a}$ [D] $\frac{1}{\sqrt{1-a^2}}$

[102] _____

103. 010508b, P.I. A2.A.58
The expression $\frac{\tan\theta}{\sec\theta}$ is equivalent to

[A] $\cos\theta$ [B] $\frac{\sin\theta}{\cos^2\theta}$

[C] $\sin\theta$ [D] $\frac{\cos^2\theta}{\sin\theta}$

[103] _____

104. 010402b, P.I. A2.A.58
The expression $\frac{\sec\theta}{\csc\theta}$ is equivalent to

[A] $\cos\theta$ [B] $\frac{\sin\theta}{\cos\theta}$

[C] $\sin\theta$ [D] $\frac{\cos\theta}{\sin\theta}$

[104] _____

105. 060515b
A crate weighing *w* pounds sits on a ramp positioned at an angle of θ with the horizontal. The forces acting on this crate are modeled by the equation $Mw\cos\theta = w\sin\theta$, where *M* is the coefficient of friction. What is an expression for *M* in terms of θ?

[A] $M = \sec\theta$ [B] $M = \csc\theta$

[C] $M = \tan\theta$ [D] $M = \cot\theta$

[105] _____

NY LESSON 10

TRIGONOMETRIC EQUATIONS

106. 080610b, P.I. A2.A.68
A solution set of the equation $5\sin\theta + 3 = 3$ contains all multiples of

[A] 135° [B] 90° [C] 180° [D] 45°

[106] _____

107. 010523b, P.I. A2.A.68
Solve the following equation algebraically for all values of θ in the interval $0° \le \theta \le 180°$.

$$2\sin\theta - 1 = 0$$

[107] _____

108. 010630b, P.I. A2.A.68
An architect is using a computer program to design the entrance of a railroad tunnel. The outline of the opening is modeled by the function $f(x) = 8\sin x + 2$, in the interval $0 \le x \le \pi$, where *x* is expressed in radians. Solve algebraically for all values of *x* in the interval $0 \le x \le \pi$, where the height of the opening, f(*x*), is 6. Express your answer in terms of π. If the *x*-axis represents the base of the tunnel, what is the maximum height of the entrance of the tunnel?

[108] _____

109. 060319b, P.I. A2.A.68
What value of *x* in the interval $0° \le x \le 180°$ satisfies the equation $\sqrt{3}\tan x + 1 = 0$?

[A] -30° [B] 60° [C] 30° [D] 150°

[109] _____

110. 080432b, P.I. A2.A.68
Solve algebraically for all values of θ in the interval $0° \le \theta \le 360°$ that satisfy the equation $\frac{\sin^2\theta}{1+\cos\theta} = 1$.

[110] _____

111. 060131b, P.I. A2.A.68
In the interval $0° \le A \le 360°$, solve for all values of A in the equation $\cos 2A = -3\sin A - 1$.

[111] _____

112. 060427b, P.I. A2.A.68
Navigators aboard ships and airplanes use nautical miles to measure distance. The length of a nautical mile varies with latitude. The length of a nautical mile, L, in feet, on the latitude line θ is given by the formula $L = 6{,}077 - 31\cos 2\theta$. Find, to the *nearest degree*, the angle θ, $0 \le \theta \le 90°$, at which the length of a nautical mile is approximately 6,076 feet.

[112] _____

113. 010832b, P.I. A2.A.68
The horizontal distance, in feet, that a golf ball travels when hit can be determined by the formula $d = \frac{v^2 \sin 2\theta}{g}$, where v equals initial velocity, in feet per second; g equals acceleration due to gravity; θ equals the initial angle, in degrees, that the path of the ball makes with the ground; and d equals the horizontal distance, in feet, that the ball will travel. A golfer hits the ball with an initial velocity of 180 feet per second and it travels a distance of 840 feet. If g = 32 feet per second per second, what is the smallest initial angle the path of the ball makes with the ground, to the *nearest degree*?

[113] _____

114. 060530b, P.I. A2.A.68
Find, to the *nearest degree*, all values of θ in the interval $0° < \theta < 360°$ that satisfy the equation $3\cos 2\theta + \sin\theta - 1 = 0$.

[114] _____

115. 010829b, P.I. A2.A.68
Find all values of x in the interval $0° < x < 360°$ that satisfy the equation $3\cos x + \sin 2x = 0$.

[115] _____

116. 010317b, P.I. A2.A.58
If $(\sec x - 2)(2\sec x - 1) = 0$, then x terminates in

[A] Quadrants I and II, only

[B] Quadrants I and IV, only

[C] Quadrant I, only

[D] Quadrants I, II, III, and IV

[116] _____

117. 010727b, P.I. A2.A.68
Find, to the *nearest degree*, all values of θ in the interval $0° \le \theta \le 180°$ that satisfy the equation $8\cos^2\theta - 2\cos\theta - 1 = 0$.

[117] _____

118. 010404b, P.I. A2.A.27
What is a positive value of x for which $9^{-\cos x} = \frac{1}{3}$?

[A] 60° [B] 30° [C] 45° [D] 90°

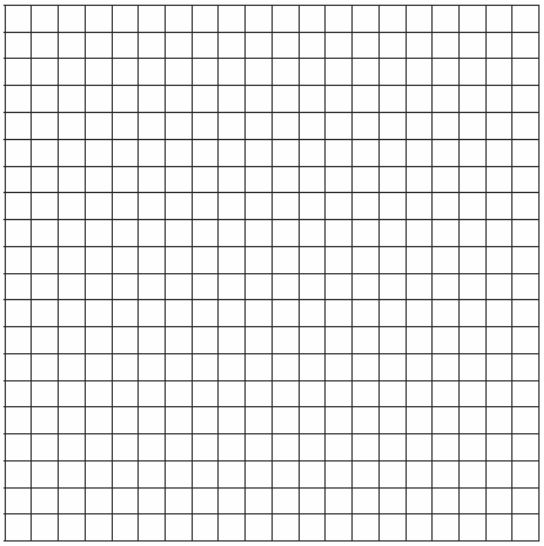
[118] _____

119. 010320b, P.I. A2.A.66
If sin 6A = cos 9A, then $m\angle A$ is equal to

[A] 36 [B] 6 [C] 54 [D] $1\frac{1}{2}$

[119] _____

120. 060731b, P.I. A2.A.68
The average annual snowfall in a certain region is modeled by the function $S(t) = 20 + 10\cos(\frac{\pi}{5}t)$, where *S* represents the annual snowfall, in inches, and *t* represents the number of years since 1970. What is the minimum annual snowfall, in inches, for this region? In which years between 1970 and 2000 did the minimum amount of snow fall? [The use of the grid is optional.]



[120] _____

NY LESSON 11

DOUBLE ANGLE AND ANGLE SUM AND DIFFERENCE IDENTITIES

121. 010512b, P.I. A2.A.77
If *A* is a positive acute angle and $\sin A = \frac{\sqrt{5}}{3}$, what is cos *2A*?

[A] $-\frac{1}{3}$ [B] $\frac{1}{9}$ [C] $-\frac{1}{9}$ [D] $\frac{1}{3}$

[121] _____

122. 010418b, P.I. A2.A.77
If *x* is an acute angle and $\sin x = \frac{12}{13}$, then $\cos 2x$ equals

[A] $-\frac{119}{169}$ [B] $\frac{25}{169}$

[C] $-\frac{25}{169}$ [D] $\frac{119}{169}$

[122] _____

123. 010319b, P.I. A2.A.77
If $\sin\theta = \frac{\sqrt{5}}{3}$, then $\cos 2\theta$ equals

[A] $\frac{1}{9}$ [B] $-\frac{1}{9}$ [C] $-\frac{1}{3}$ [D] $\frac{1}{3}$

[123] _____

124. 060413b, P.I. A2.A.77
If θ is an acute angle such that $\sin\theta = \frac{5}{13}$, what is the value of $\sin 2\theta$?

[A] $\frac{60}{169}$ [B] $\frac{12}{13}$ [C] $\frac{10}{26}$ [D] $\frac{120}{169}$

[124] _____

125. 010609b, P.I. A2.A.77
If θ is a positive acute angle and $\sin 2\theta = \frac{\sqrt{3}}{2}$, then $(\cos\theta + \sin\theta)^2$ equals

[A] $1 + \frac{\sqrt{3}}{2}$ [B] 30° [C] 60° [D] 1

[125] _____

126. 060604b, P.I. A2.A.77

If x is a positive acute angle and $\sin x = \frac{1}{2}$, what is $\sin 2x$?

[A] $\frac{\sqrt{3}}{2}$ [B] $\frac{1}{2}$ [C] $-\frac{1}{2}$ [D] $-\frac{\sqrt{3}}{2}$

[126] _____

127. 080617b, P.I. A2.A.77

The expression $\frac{\sin 2\theta}{\sin^2 \theta}$ is equivalent to

[A] $2\cot\theta$ [B] $\frac{2}{\sin\theta}$

[C] $2\cos\theta$ [D] $2\tan\theta$

[127] _____

128. 080315b, P.I. A2.A.77

The expression $\frac{2\cos\theta}{\sin 2\theta}$ is equivalent to

[A] cot θ [B] sin θ

[C] sec θ [D] csc θ

[128] _____

129. 080126b, P.I. A2.A.76

If $\sin x = \frac{4}{5}$, where $0° < x < 90°$, find the value of cos (x + 180°).

[129] _____

130. 060312b, P.I. A2.A.76

If A and B are positive acute angles, $\sin A = \frac{5}{13}$, and $\cos B = \frac{4}{5}$, what is the value of $\sin(A+B)$?

[A] $-\frac{16}{65}$ [B] $\frac{56}{65}$ [C] $\frac{63}{65}$ [D] $\frac{33}{65}$

[130] _____

131. 080409b, P.I. A2.A.76

If $\sin A = \frac{4}{5}$, $\tan B = \frac{5}{12}$, and angles A and B are in Quadrant I, what is the value of $\sin(A+B)$?

[A] $-\frac{33}{65}$ [B] $\frac{33}{65}$ [C] $\frac{63}{65}$ [D] $-\frac{63}{65}$

[131] _____

132. 080316b, P.I. A2.A.76

If $\sin x = \frac{12}{13}$, $\cos y = \frac{3}{5}$, and x and y are acute angles, the value of $\cos(x-y)$ is

[A] $\frac{21}{65}$ [B] $-\frac{33}{65}$ [C] $-\frac{14}{65}$ [D] $\frac{63}{65}$

[132] _____

133. 010401b, P.I. A2.A.76

The expression $\cos 40° \cos 10° + \sin 40° \sin 10°$ is equivalent to

[A] $\cos 50°$ [B] $\sin 30°$

[C] $\cos 30°$ [D] $\sin 50°$

[133] _____

[1] A

[2] A

[3] B

[4] B

[5] [2] 307, 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] Appropriate work is shown to find the value of the reference angle, but no further correct work is shown.
or [1] 307, 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] D

[7] A

[8] [2] $-\frac{4}{5}$ or -0.8, and appropriate work is shown.
[1] $\frac{4}{5}$ or 0.8, and appropriate work is shown, but the quadrant was not taken into consideration.
or [1] $-\frac{4}{5}$ or -0.8, 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.

[9] B

[10] B

[11] D

[12] A

[13] A

[14] B

[15] B

[16] B

[17] B

[18] B

[19] [2] No, and appropriate work is shown, such as setting the expressions equal to each other, with one trial showing that the two expressions are not always equal.
[1] No, but only one trial shows that the two expressions are not always equal.
or [1] Yes, but appropriate work is shown, such as using 0° and 180° as trials.
[0] No or yes, and no work or incorrect work is shown.
or [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

[20] [2] 105, and appropriate work is shown, such as $\frac{7\pi}{12}\cdot\frac{180}{\pi}$.
[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] 105, 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.

[21] B

[22] D

[23] D

[2] $\frac{\pi}{3}$, and appropriate work or an appropriate diagram is shown.
[1] Appropriate work is shown, but the answer is not expressed in simplest form.
or [1] A correct diagram is drawn, but no answer or an incorrect answer is found.
or [1] 60°, and appropriate work or an appropriate diagram is shown.
or [1] $\frac{\pi}{3}$, 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.

[24]

[2] $\frac{5\pi}{4}$ or an equivalent answer in radian measure, 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] 225 or 225°, but appropriate work is shown.
or [1] The measure of the angle in a counterclockwise rotation is found, resulting in an answer of $\frac{3\pi}{4}$.
or [1] $\frac{5\pi}{4}$ or an equivalent answer in radian measure, 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.

[25]

[2] 0.345, and appropriate work is shown, such as solving the equation $\theta = \frac{1.38}{4}$.
[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] 0.345, 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.

[26]

[27] B

[28] C

[4] 94, 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.
or [2] Appropriate work is shown, and the correct radian value is found for è, but it is not converted to degrees.
or [2] Both formulas are set up correctly, but no further correct work is shown.
or [2] An incorrect radian value is found for è, but it is converted correctly to degrees.
[1] Only one formula is set up correctly, and no further correct work is shown.
or [1] 94, 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.

[29]

[2] 4, 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] 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.

[30]

[2] 20, and appropriate work is shown, such as using the formula $S = r\theta$.
[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] 20, 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.

[31]

[32] C

[33] B

[34] B

[2] 9.42, and appropriate work is shown, such as changing the angle to radians and finding s.
[1] The formula $s = \theta r$ is stated, but 54° is not converted to radian measure.
or [1] Appropriate work is shown, but one computational or rounding error is made.
or [1] 9.42, 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 incorrect procedure.

[35]

[2] 621.1, 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.
or [1] A correct formula is written, but incorrect substitutions are made.
or [1] An incorrect proportion is written, but an appropriate solution is found.
or [1] The correct circumference is found, but no further correct work is shown.
or [1] 621.1, 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.

[36]

[2] 6.9. and appropriate work is shown, such as $2.4 \cdot 165 \cdot \frac{\pi}{180}$.
[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] Appropriate work is shown, but the calculations are performed in radians.
or [1] Correct substitution is made into the equation for the length of the arc, but no further correct work is shown.
or [1] 6.9, 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.

[37]

[38] A

[39] A

[40] B

[41] C

[42] A

[43] D

[2] 8, 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] 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.

[44]

[45] C

[46] A

[47] A

[48] C

[49] A

[50] B

[51] B

[52] D

[53] A

[54] A

[55] A

[56] A

[57] A

[58] B

[59] [4] $y = 2\sin\frac{1}{2}x+3$ or $y=-2\sin\frac{1}{2}x+3$, and appropriate work is shown.
[3] The fact that c is equal to 3 is not recognized, resulting in an answer of $y=2\sin\frac{1}{2}x$ or $y=-2\sin\frac{1}{2}x$.
or [3] The values of a, b, and c are determined correctly, and appropriate work is shown, but the equation is not written.
or [3] The value of a or c is determined incorrectly, but the value of b is determined correctly, and appropriate work is shown, and an appropriate equation is written.
[2] Only the value of b is determined correctly, but appropriate work is shown, and an appropriate equation is written.
or [2] Only the values of a and c are determined correctly, but appropriate work is shown, and an appropriate equation is written.
[1] The value of a or c is determined incorrectly, and the value of b is not determined or is determined incorrectly, but appropriate work is shown, and an appropriate equation is written.
or [1] $y=2\sin\frac{1}{2}x+3$ or $y=-2\sin\frac{1}{2}x+3$, 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.

[4] $A = 1.5$, $B = 0.5$, and $D = 6.5$ or an equivalent answer, and appropriate work is shown or an appropriate explanation is given for each number found.
[3] Correct answers are found, but appropriate work is shown or an appropriate explanation is given for only two of the numbers found.
[2] Only two correct answers are found, but appropriate work is shown or an appropriate explanation is given for the two answers.
[1] Only one correct answer is found, but appropriate work is shown or an appropriate explanation is given for that answer.
or [1] $A = 1.5$, $B = 0.5$, and $D = 6.5$ 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.

[60]

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[4] 4.1 and the equation $T = 8 \cos t + 78$ is graphed correctly and appropriate work is shown to determine the amount of time, such as using the table function of the graphing calculator or estimating (3.9-4.3 hours) based on the graph.
[3] The equation $T = 8 \cos t + 78$ is graphed correctly and the correct intervals are stated, but the number of hours is not found or is incorrect.
[2] The equation $T = 8 \cos t + 78$ is graphed correctly, but no further correct work is shown.
or [2] The equation $T = 8 \cos t + 78$ is graphed incorrectly, but an appropriate number of hours is found, based on the incorrect graph.
[1] 4.1, 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.

[61]

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[6] 8, and appropriate work is shown, such as a correctly labeled graph, a table of values, or an algebraic solution.
[5] Appropriate work is shown, but one computational or graphing error is made.
[4] Appropriate work is shown, but two or more computational or graphing errors are made.
or [4] Appropriate work is shown, and the correct values of t where the height of the tide is 7 are identified (2 and 10), but the correct number of hours is not stated.
[3] Appropriate work is shown, but one conceptual error is made.
or [3] A correct table or graph is constructed, but no further correct work is shown.
[2] Appropriate work is shown, but one conceptual error and one computational or graphing error are made.
or [2] The correct values of t (2 and 10) and 8 are written, but no work is shown.
[1] 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.

[62]

[4] Both equations are graphed correctly over the specified domain and the interval $-\frac{\pi}{3} \le x \le \frac{\pi}{3}$ is identified.
[3] Appropriate work is shown, but one computational or graphing error is made.
or [3] Both equations are graphed correctly over the specified domain, but the interval is not identified or is written as -1.0472 ≤ x ≤ 1.0472 or -60° ≤ x ≤ 60° or $-\frac{\pi}{3} < x < \frac{\pi}{3}$.
[2] Appropriate work is shown, but two or more computational or graphing errors are made.
or [2] Appropriate work is shown, but one conceptual error is made, such as graphing y = 4 sin x.
or [2] The equation y = 4 cos x is graphed correctly over the specified domain, but no further correct work is shown.
[1] Appropriate work is shown, but one conceptual error and one computational or graphing error are made.
or [1] $-\frac{\pi}{3} \le x \le \frac{\pi}{3}$, but no work is shown and no graphs are drawn.
[0] The equation y = 2 is graphed correctly, but no further correct work is shown.
or [0] -1.0472 < x < 1.0472 or -60° < x < 60° or $-\frac{\pi}{3} < x < \frac{\pi}{3}$, and 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 obviously incorrect procedure.

[63]

[4] Two, and the paths are sketched and labeled correctly, and appropriate work is shown.
[3] Appropriate work is shown, but one computational or graphing error is made, but the appropriate number of points of intersection is stated.
or [3] Only one path is sketched correctly, but the correct interval is used, and an appropriate number of points of intersection is stated.
or [3] The paths are sketched correctly, but an incorrect interval is used, but the appropriate number of points of intersection is stated.
or [3] The paths are sketched correctly in the correct interval, but the number of points of intersection is not stated or is stated incorrectly.
[2] Appropriate work is shown, but more than one computational or graphing error is made, but the appropriate number of points of intersection is stated.
or [2] Only one path is sketched correctly in the correct interval, and the number of points of intersection is not stated or is stated incorrectly.
or [2] Only one path is sketched appropriately in an incorrect interval, but an appropriate number of points of intersection is stated.
[1] A basic sine and cosine curve are sketched, but they do not have the correct traits of the equation, but an appropriate number of points of intersection is stated.
or [1] One path is sketched correctly in the correct interval, but the second graph is not sketched.
[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

[64]

[6] 30, 150, and 270, and appropriate work is shown.
[5] Appropriate work is shown, but one computational error is made.
[4] The correct equation is shown, but only two correct solutions are found.
[3] The correct equation is shown, but only one correct solution is found.
[2] The correct equation is solved for x, but no further work is shown.
[1] The correct equation is shown, but no further work is shown.
or [1] 30, 150, and 270, 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.

[65]

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[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 incorrect procedure.

[66]

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[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 incorrect procedure.

[67]

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[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 incorrect procedure.

[68]

[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.

[69]

[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 incorrect procedure.

[70]

[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.

[71]

[72] B

[73] B

[2] 3, and appropriate work is shown, such as $\frac{10}{\sin 53^\circ} = \frac{b}{\sin 14^\circ}$.
[1] Appropriate work is shown, but one computational or rounding error is made.
or [1] The proportion $\frac{10}{\sin 53^\circ} = \frac{b}{\sin 14^\circ}$ 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.

[74]

[75] B

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

[76]

[77] A

[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.

[78]

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[4] $BC = 6.75$ and the area of $\Delta ABC = 16.7055$ 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 $\Delta ABC = 16.7055$ 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.

[79]

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[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 obviously incorrect procedure.

[80]

[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 incorrect procedure.

[81]

[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 obviously incorrect procedure.

[82]

[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 incorrect procedure.

[83]

[4] 88, and appropriate work is shown, such $\frac{y}{\sin 32} = \frac{100}{\sin 33}$ and $\sin 65 = \frac{x}{y}$.
[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 incorrect procedure.

[84]

[6] 330, and appropriate work is shown, such as solving $\frac{\sin 13}{250} = \frac{\sin 37}{y}$ and calculating $\cos 50 = \frac{x}{668.8288536}$ 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 incorrect procedure.

[85]

[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 incorrect procedure.

[86]

[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 incorrect procedure.

[87]

[88] C

[89] B

[90] D

[91] B

[92] B

[2] Two, and appropriate work is shown or an appropriate diagram is drawn.
[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] Appropriate work is shown, but only one correct solution is found.
or [1] Two, 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.

[93]

[94] D

[95] C

[96] B

[97] A

[98] C

[2] 2 cos x, and appropriate work is shown, such as factoring the numerator and substituting $\cos^2 x$ for $1-\sin^2 x$.
[1] Appropriate work is shown, but one factoring or substitution error is made, or the expression is not simplified completely.
or [1] Appropriate work is shown, but one conceptual error is made.
or [1] 2 cos x, 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.

[99]

[100] C

[101] A

[102] B

[103] C

[104] B

[105] C

[106] C

[2] 30 and 150, 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] Appropriate work is shown, but only 30 or 150 is found.
or [1] 30 and 150, but no work is shown.
[0] 30 or 150, but no work is shown.
or [0] The value of $\sin\theta$ is shown to be $\frac{1}{2}$.
or [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

[107]

[4] $\frac{\pi}{6}$ and $\frac{5\pi}{6}$ and 10, and appropriate work is shown.
[3] Appropriate work is shown, but one computational error is made.
or [3] $x = 0.52$ and $x = 2.62$ or $x = 30°$ and $x = 150°$ and 10, and appropriate work is shown.
or [3] $\frac{\pi}{6}$ and $\frac{5\pi}{6}$, and appropriate work is shown, but the maximum height is missing.
[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.
or [2] $x = 0.52$ and $x = 2.62$ or $x = 30°$ and $x = 150°$, and appropriate work is shown, but the maximum height is missing.
or [2] $\frac{\pi}{6}$ or $\frac{5\pi}{6}$ and 10, and appropriate work is shown.
[1] Appropriate work is shown, but one conceptual error and one computational error are made.
or [1] 30° or 150° and 10, and appropriate work is shown.
or [1] $\frac{\pi}{6}$ and $\frac{5\pi}{6}$ and 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 incorrect procedure.

[108]

[109] D

[4] 90 and 270, and appropriate work is shown, such as solving $\sin^2\theta = 1 + \cos\theta$.
[3] Appropriate work is shown, but one computational error is made or the answers are expressed in radians.
or [3] Appropriate work is shown, but 180 is not rejected as a solution.
or [3] Appropriate work is shown, but only one solution is found.
[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.
or [2] An incorrect trigonometric substitution is made, but the equation is solved appropriately.
or [2] A trigonometric equation set equal to zero is written, but no further correct work is shown.
or [2] 90 and 270, but a graphic solution is provided.
[1] The equation $\sin^2\theta - \cos\theta - 1 = 0$ is found, but no further correct work is shown.
or [1] A graphic solution is provided, and one computational or graphing error is made.
or [1] 90 and 270, but no work is shown.
[0] 90 or 270, but no work is shown.
or [0] 90, 180, and 270, 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 obviously incorrect procedure.

[110]

[4] 210° and 330°, and appropriate work is shown.
[3] Correct substitution and factoring are shown, with at least the reference angle of 30° found.
or [3] Correct substitution is shown, and the equation is put in standard form and factored correctly, but an incorrect reference angle is used to find appropriate answers.
or [3] An incorrect quadratic equation is solved correctly, and appropriate angles are determined.
[2] Correct substitution is shown, and the equation is put in standard form and factored correctly, but no angles are found.
[1] Correct substitution is shown, but the equation is not factored or is factored incorrectly.
or [1] 210° and 330°, but no work is shown.
[0] 210° or 330° or 30°, 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 obviously incorrect procedure.

[111]

[4] 44, and appropriate work is shown, such as solving the equation $6{,}076 = 6{,}077 - 31\cos 2\theta$.
[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] An incorrect equation of equal difficulty is solved appropriately.
[1] Appropriate work is shown, but one conceptual error and one computational error are made.
or [1] 44, 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.

[112]

[4] 28, and appropriate work is shown, such as substituting into the given equation or solving the equation graphically.
[3] Appropriate work is shown, but one computational, rounding, or graphing error is made.
or [3] Appropriate work is shown, but 56, the value of 2θ, is given as the answer.
[2] Appropriate work is shown but two or more computational, rounding, or graphing 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, rounding, or graphing error are made.
or [1] Appropriate work is shown to find the value of sin 2θ, but no further correct work is shown.
or [1] 28, 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.

[113]

[4] 42, 138, 210, and 330, and appropriate work is shown, such as substituting for cos 2θ and solving the resulting quadratic equation.
[3] Appropriate work is shown, but one computational or rounding error is made.
or [3] Incorrect substitution is made for cos 2θ, such as $1-\sin^2\theta$, but all further work is appropriate.
[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.
or [2] Correct substitution is made, and appropriate work is shown to obtain the values of sin θ, but the values of θ are not found.
or [2] A quadratic equation in terms of sin θ is written in standard form, but no further correct work is shown.
[1] Appropriate work is shown, but one conceptual error and one computational error are made.
or [1] Correct substitution is made for cos 2θ, but no further correct work is shown.
or [1] 42, 138, 210, and 330, but no work is shown. [All four answers must be identified to receive this credit.]
[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

[114]

[4] 90° and 270°, and appropriate work is shown, such as solving the equation $3\cos x + 2\sin x \cos x = 0$ or sketching a graph and finding the *x*-intercepts.
[3] Appropriate work is shown, but one computational, factoring, or graphing error is made.
or [3] Appropriate work is shown, but the answers are expressed in radian measure.
[2] Appropriate work is shown, but two or more computational, factoring, or graphing errors are made.
or [2] Appropriate work is shown, but one conceptual error is made,
or [2] An appropriate graph is sketched, but no further correct work is shown.
[1] Appropriate work is shown, but one conceptual error and one computational, factoring, or graphing error are made.
or [1] Correct substitution is made for sin 2*x*, but no further correct work is shown.
or [1] 90° and 270°, but no work is shown.
[0] 90° or 270°, 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 obviously incorrect procedure.

[115]

[116] B

[4] 60 and 104, and appropriate work is shown either algebraically or graphically.
[3] Appropriate work is shown, but one computational or rounding error is made.
or [3] Appropriate work is shown, but only one correct angle is found.
or [3] 60 and 104, and appropriate work is shown, but additional angles outside the interval are 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] $\cos\theta = -\frac{1}{4}$ and $\cos\theta = -\frac{1}{2}$, 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] 60 and 104, but no work is shown.
[0] 60 or 104, 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 obviously incorrect procedure.

[117]

[118] A

[119] B

[4] 10 and 1975, 1985, and 1995, and appropriate work is shown or an appropriate explanation is written.
[3] Appropriate work is shown, but one computational or graphing error is made.
or [3] 10, and appropriate work is shown, but only two of the years are found.
[2] Appropriate work is shown, but two or more computational or graphing errors are made.
or [2] Appropriate work is shown, but one conceptual error is made, such as graphing an incorrect function.
or [2] An incorrect equation of equal difficulty is solved appropriately.
or [2] 1975, 1985, and 1995, and appropriate work is shown or an appropriate explanation is written, but the minimum snowfall is not found.
[2] 10, and appropriate work is shown, but only one of the years is found.
[1] Appropriate work is shown, but one conceptual error and one computational or graphing error are made.
or [1] 10, and appropriate work is shown or an appropriate explanation is written, but the years are not found.
or [1] 10 and 1975, 1985, and 1995, but no work is shown.
[0] 10 or 1975, 1985, and 1995, 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 obviously incorrect procedure.

[120]

[121] C

[122] A

[123] B

[124] D

[125] A

[126] A

[127] A

[128] D

[2] $-\frac{3}{5}$, and appropriate work is shown, such as $\cos(x + 180) = \cos x \cos 180° - \sin x \sin 180° = \frac{3}{5}(-1) - \frac{4}{5}(0)$.
or [2] $-\frac{3}{5}$, and appropriate work is shown, such as $\cos(x + 180) = -\cos x$.
or [2] $-\frac{3}{5}$, and angle x is found, and correct substitution leads to $\cos(x + 180)$.
[1] Appropriate work is shown, but one computational error is made.
or [1] $\cos x = \frac{4}{5}$ is found, but substitution errors are made.
or [1] $-\frac{3}{5}$, 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 incorrect procedure.

[129]

[130] B

[131] C

[132] D

[133] C