1. 060501b, P.I. A2.A.51
The accompanying graph shows the heart rate, in beats per minute, of a jogger during a 4-minute interval.

What is the range of the jogger's heart rate during this interval?

[A] 60-110 [B] 1-4

[C] 0-110 [D] 0-4

2. 060502b
If $\sin\theta$ is negative and $\cos\theta$ is negative, in which quadrant does the terminal side of θ lie?

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

3. 060503b, P.I. A2.A.58
Expressed as a function of a positive acute angle, sin (-230°) is equal to

[A] -cos 50° [B] -sin 50°

[C] sin 50° [D] cos 50°

4. 060504b, P.I. A.A.16
Written in simplest form, the expression $\frac{x^2-9x}{45x-5x^2}$ is equivalent to

[A] $\frac{1}{5}$ [B] -5 [C] $-\frac{1}{5}$ [D] 5

5. 060505b, P.I. A2.A.1
Which graph represents the solution set for the expression $|2x+3|>7$?

[A] 

[B] 

[C] 

[D] 

6. 060506b, P.I. G.G.73
What are the coordinates of the center of the circle represented by the equation $(x+3)^2+(y-4)^2=25$?

[A] (3,4) [B] (-3,4)

[C] (3,-4) [D] (-3,-4)

7. 060507b, P.I. A2.S.3
What is the mean of the data in the accompanying table?

Scores (x_i)	Frequency (f_i)
25	3
20	2
11	5
10	4

[A] 14.5 [B] 16 [C] 15 [D] 11

8. 060508b
In a given rectangle, the length varies inversely as the width. If the length is doubled, the width will

[A] remain the same

[B] increase by 2 [C] be multiplied by 2

[D] be divided by 2

9. 060509b, P.I. A2.N.9
Impedance measures the opposition of an electrical circuit to the flow of electricity. The total impedance in a particular circuit is given by the formula $Z_T = \frac{Z_1 Z_2}{Z_1 + Z_2}$. What is the total impedance of a circuit, Z_T, if $Z_1 = 1 + 2i$ and $Z_2 = 1 - 2i$?

[A] 0 [B] 1 [C] $-\frac{3}{2}$ [D] $\frac{5}{2}$

10. 060510b, P.I. A2.A.19
If $\log a = x$ and $\log b = y$, what is $\log a\sqrt{b}$?

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

[C] $2x + 2y$ [D] $x + 2y$

11. 060511b, P.I. A2.A.38
Which relation is a function?

[A] $xy = 7$ [B] $x = 7$

[C] $x^2 + y^2 = 7$ [D] $x^2 - y^2 = 7$

12. 060512b
Which equation, when graphed on a Cartesian coordinate plane, would best represent an elliptical racetrack?

[A] $3x + 10y = 288{,}000$

[B] $3x^2 - 10y^2 = 288{,}000$

[C] $3x^2 + 10y^2 = 288{,}000$

[D] $30xy = 288{,}000$

13. 060513b, P.I. A2.N.9
The expression $\frac{2+i}{3+i}$ is equivalent to

[A] $\frac{7+i}{10}$ [B] $\frac{6+5i}{8}$

[C] $\frac{6+i}{8}$ [D] $\frac{7-5i}{10}$

14. 060514b, P.I. A.A.41
For which quadratic equation is the axis of symmetry $x = 3$?

[A] $y = x^2 + 6x + 3$ [B] $y = -x^2 + 6x + 2$

[C] $y = -x^2 + 3x + 5$ [D] $y = x^2 + x + 3$

15. 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] $M = \tan\theta$

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

16. 060516b

If $(a^x)^{\frac{2}{3}} = \frac{1}{a^2}$, what is the value of *x*?

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

17. 060517b, P.I. A2.A.36

What is the third term in the expansion of $(\cos x + 3)^5$?

[A] $270\cos^2 x$ [B] $90\cos^2 x$

[C] $90\cos^3 x$ [D] $60\cos^3 x$

18. 060518b, P.I. A2.A.2

Which equation has imaginary roots?

[A] $x(x + 6) = -10$ [B] $(2x + 1)(x - 3) = 7$

[C] $x(5 - x) = -3$ [D] $x(5 + x) = 8$

19. 060519b

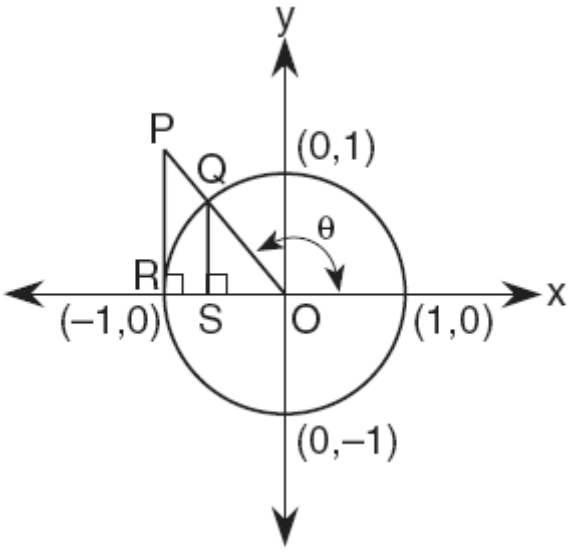
The graphs of the equations $y = 2^x$ and $y = -2x + a$ intersect in Quadrant I for which values of *a*?

[A] $a < 1$ [B] $a > 1$

[C] $0 < a < 1$ [D] $a \geq 1$

20. 060520b

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

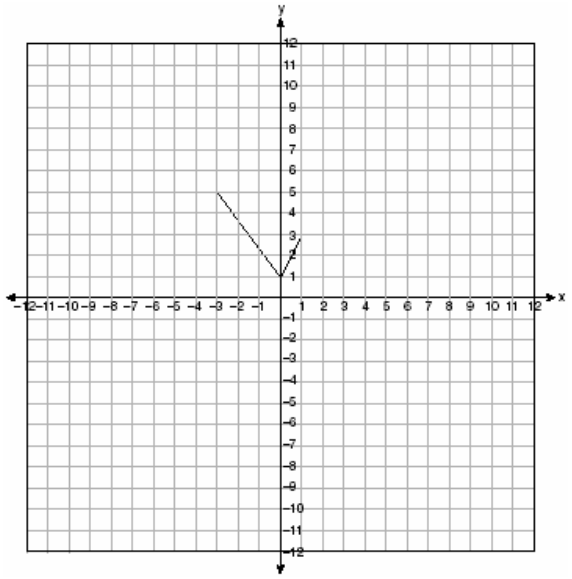


Which measure represents $\sin\theta$?

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

21. 060521b, P.I. G.G.58

The graph of the function *g(x)* is shown on the accompanying set of axes. On the same set of axes, sketch the image of *g(x)* under the transformation D_2.



22. 060522b, P.I. A2.A.27
Solve for *m*: $3^{m+1} - 5 = 22$

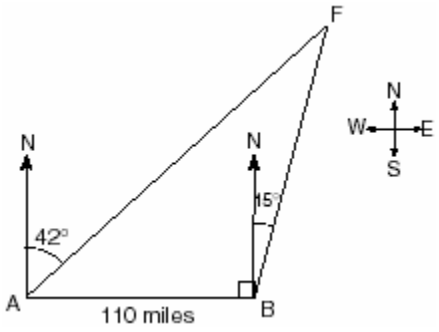
23. 060523b, P.I. A2.N.10
Evaluate: $\sum_{k=0}^{3}(3\cos k\pi + 1)$

24. 060524b, P.I. A2.A.16
Express in simplest form: $\frac{1}{x} + \frac{1}{x+3}$

25. 060525b, P.I. A2.A.73
A landscape architect is designing a triangular garden to fit in the corner of a lot. The corner of the lot forms an angle of 70°, and the sides of the garden including this angle are to be 11 feet and 13 feet, respectively. Find, to the *nearest integer*, the number of square feet in the area of the garden.

26. 060526b, P.I. A2.A.42
A certain drug raises a patient's heart rate, $h(x)$, in beats per minute, according to the function $h(x) = 70 + 0.2x$, where *x* is the bloodstream drug level, in milligrams. The level of the drug in the patient's bloodstream is a function of time, *t*, in hours, according to the formula $g(t) = 300(0.8)^t$. Find the value of $h(g(4))$, the patient's heart rate in beats per minute, to the *nearest whole number*.

27. 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*?

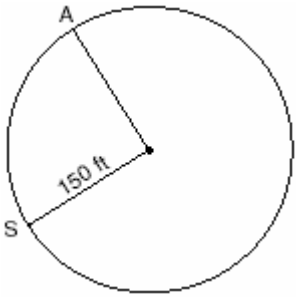


28. 060528b, P.I. A2.A.22
Solve for all values of *q* that satisfy the equation $\sqrt{3q+7} = q + 3$.

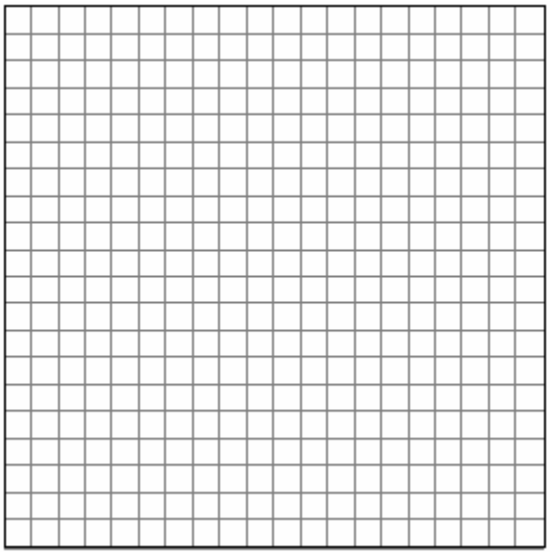
29. 060529b, P.I. A2.S.15
The probability that a planted watermelon seed will sprout is $\frac{3}{4}$. If Peyton plants seven seeds from a slice of watermelon, find, to the *nearest ten thousandth*, the probability that *at least* five will sprout.

30. 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 $3\cos 2\theta + \sin\theta - 1 = 0$.

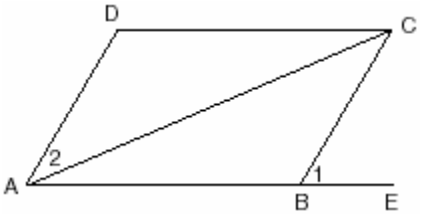
31. 060531b, P.I. A2.A.61
Kathy and Tami are at point *A* on a circular track that has a radius of 150 feet, as shown in the accompanying diagram. They run counterclockwise along the track from *A* to *S*, a distance of 247 feet. Find, to the *nearest degree*, the measure of minor arc *AS*.



32. 060532b, P.I. A2.A.4
The height of a projectile is modeled by the equation $y = -2x^2 + 38x + 10$, where *x* is time, in seconds, and *y* is height, in feet. During what interval of time, to the *nearest tenth of a second*, is the projectile *at least* 125 feet above ground? [The use of the accompanying grid is optional.]

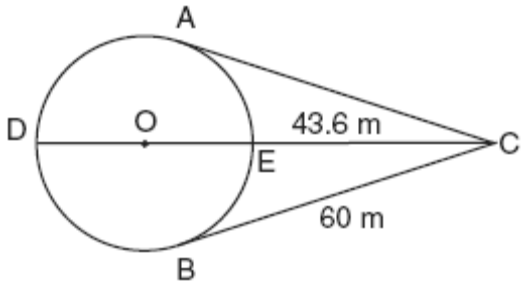


33. 060533b, P.I. G.G.27
Given: parallelogram *ABCD*, diagonal $\overline{AC}$, and $\overline{ABE}$



Prove: $m\angle 1 > m\angle 2$

34. 060534b, P.I. G.G.53
An architect is designing a park with an entrance represented by point *C* and a circular garden with center *O*, as shown in the accompanying diagram. The architect plans to connect three points on the circumference of the garden, *A*, *B*, and *D*, to the park entrance, *C*, with walkways so that walkways $\overline{CA}$ and $\overline{CB}$ are tangent to the garden, walkway $\overline{DOEC}$ is a path through the center of the garden, $m\overset{\frown}{ADB} : m\overset{\frown}{AEB} = 3:2$, BC = 60 meters, and EC = 43.6 meters. Find the measure of the angle between walkways $\overline{CA}$ and $\overline{CB}$. Find the diameter of the circular garden, to the *nearest meter*.



[1] A

[2] A

[3] C

[4] C

[5] C

[6] B

[7] C

[8] D

[9] D

[10] A

[11] A

[12] C

[13] A

[14] B

[15] B

[16] B

[17] C

[18] A

[19] B

[20] D

[21]
[2] A graph is sketched that maps (–3,5) to (–6,10), (0,1) to (0,2), and (1,3) to (2,6).
[1] One graphing or computational error is made, but an appropriate graph is sketched.
[0] A graph is sketched that represents a dilation of only x or y.
or [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

[22]
[2] 2, 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] 2, but no work is shown.
[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

[23]
[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.

[24]
[2] $\frac{2x+3}{x(x+3)}$ or $\frac{2x+3}{x^2+3x}$, and appropriate work is shown.
[1] Appropriate work is shown, but one computational error is made or the answer is not simplified completely.
or [1] Appropriate work is shown, but one conceptual error is made.
or [1] $\frac{2x+3}{x(x+3)}$ or $\frac{2x+3}{x^2+3x}$, 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] 67, and appropriate work is shown, such as $A = \frac{1}{2}(11)(13)\sin 70°$.
[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] 67, 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] 95, and appropriate work is shown.
[1] Appropriate work is shown, but one computational or rounding error is made.
or [1] Appropriate work is shown, but one conceptual error is made, such as calculating g(h(4)).
or [1] 95, 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]

[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.
[27]

[4] –2 and –1, and appropriate work is shown.
[3] Appropriate work is shown, but one computational error is made.
or [3] Appropriate work is shown, but only one value of q 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, such as squaring only the left side of the equation.
[1] Appropriate work is shown, but one conceptual error and one computational error are made.
or [1] –2 and –1, but no work is shown.
[0] –2 or –1, 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.
[28]

[4] .7564 or an equivalent answer, and appropriate work is shown, such as finding the sum of the exact probabilities that five, six, or seven seeds will sprout.
[3] Appropriate work is shown, but one computational or rounding error is made.
or [3] The probability that at most five seeds will sprout is calculated correctly, and appropriate work is shown.
[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] The three exact probabilities are found correctly, but they are not added.
or [2] The sum of only two of the three probabilities is found correctly, such as exactly six plus exactly seven, and appropriate work is shown.
[1] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.
or [1] The probability that exactly five seeds will sprout is determined appropriately.
or [1] The substitution for the sum of the three probabilities is indicated, but no further correct work is shown.
or [1] .7564 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.

[29]

[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.

[30]

[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.

[31]

[4] $3.8 \le x \le 15.2$, and appropriate work is shown, such as using the quadratic formula or sketching the graph of the parabola and the line.
[3] Appropriate work is shown, but one computational, rounding, or graphing error is made.
or [3] $3.8 < x < 15.2$, and appropriate work is shown.
[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.
or [2] The graph of the parabola and the line are sketched correctly, but no further correct work is shown.
[1] Appropriate work is shown, but one conceptual error and one computational, rounding, or graphing error are made.
or [1] Correct substitution is made into the quadratic formula, but no further correct work is shown.
or [1] The graph of the parabola is sketched correctly, but no further correct work is shown.
or [1] $3.8 \le x \le 15.2$, but no work is shown.
[0] $3.8 < x < 15.2$, 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.

[32]

[6] A complete and correct proof is written.
[5] A proof is written that demonstrates a thorough understanding of the method of proof and contains no conceptual errors, but one statement and/or reason is missing or is incorrect.
[4] A proof is written that demonstrates a good understanding of the method of proof and contains no conceptual errors, but two statements and/or reasons are missing or are incorrect.
[3] A proof is written that demonstrates a good understanding of the method of proof, but one conceptual error is made.
[2] Some correct relevant statements about the proof are made, but three or four statements and/or reasons are missing or are incorrect.
[1] Only one correct statement and reason are written.
[0] The "given" and/or the "prove" statements are rewritten in the style of a formal proof, but no further correct relevant statements are written.
or [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

[33]

[6] $m\angle ACB = 36$ and $DOE = 39$, and appropriate work is shown. [If trigonometry is used to find that $m\angle ACB = 35.98138002$, allow full credit for the full display of the calculator or any correctly rounded response.]
[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.
[3] Appropriate work is shown, but one conceptual error is made.
or [3] $m\angle ACB = 36$, and appropriate work is shown, but no further correct work is shown.
or [3] $DOE = 39$, and appropriate work is shown, 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] $m\angle ACB = 36$ and $DOE = 39$, but no work is shown.
[1] The measures of the arcs are found correctly, but no further correct work is shown.
or [1] $m\angle ACB = 36$ or $DOE = 39$, but no work is shown.
[0] 36 and 39, but no work is shown and the answers are not labeled.
or [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

[34]