1. 080701b, P.I. A2.A.41

   If $f(x) = (x^{-x} - x^0 + 2^x)$, then $f(3)$ is equal to

   [A] -22 [B] $8\dfrac{1}{27}$

   [C] -21 [D] $7\dfrac{1}{27}$

2. 080702b, P.I. A2.N.9

   The expression $3i(2i^2 - 5i)$ is equivalent to

   [A] $15 - 6i$ [B] $-15 - 5i$

   [C] $-1 + 0i$ [D] $15 - 5i$

3. 080703b, P.I. A2.A.58

   If $\csc\theta = -2$, what is the value of $\sin\theta$?

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

4. 080704b, P.I. A2.M.2

   What is $235°$, expressed in radian measure?

   [A] $\dfrac{47\pi}{36}$ [B] $\dfrac{36\pi}{47}$

   [C] $\dfrac{\pi}{235}$ [D] 235π

5. 080705b

   The flight paths of two Thunderbird jets are plotted on a Cartesian coordinate plane, and the equations of the jets' flight paths are represented by $y = 2^x + 3$ and $y = 0.5^x$. The best approximation of the intersection of the flight paths is

   [A] (-1.50, 2.82)   [B] (-1.72, 3.3)

   [C] (0, 1)   [D] (-2, -1)

6. 080706b, P.I. A2.A.17
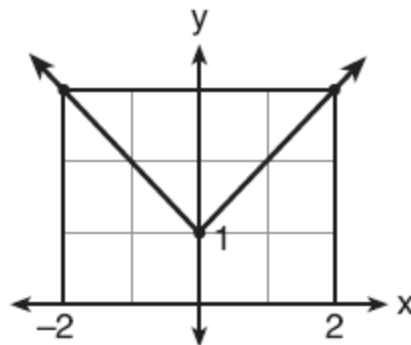
   Which expression is equivalent to the complex fraction $\dfrac{\dfrac{1}{a} - a}{\dfrac{1}{a} + 1}$?

   [A] $-(1-a)$ [B] $1-a$

   [C] -1 [D] $+1$
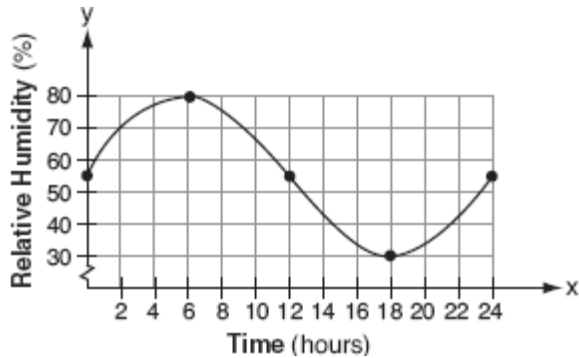
7. 080707b, P.I. A.G.4

   Which equation represents the function shown in the accompanying graph?

   [A] $f(x) = |x+1|$ [B] $f(x) = |x| - 1$

   [C] $f(x) = |x| + 1$ [D] $f(x) = |x-1|$

8. 080708b, P.I. A2.A.51
A meteorologist drew the accompanying
graph to show the changes in relative
humidity during a 24-hour period in New
York City.

What is the range of this set of data?

[A] $30 \le y \le 80$ [B] $30 \le x \le 80$

[C] $0 \le y \le 24$ [D] $0 \le x \le 24$

9. 080709b, P.I. A2.A.19
The equation used to determine the time it
takes a swinging pendulum to return to its

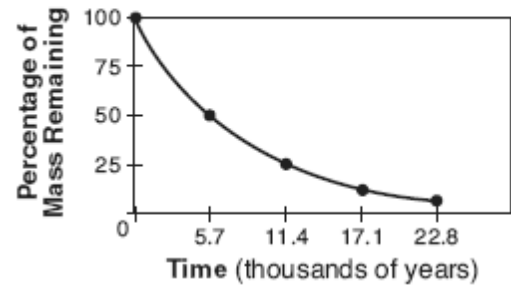starting point is $T = 2\pi \sqrt{\dfrac{\ell}{g}}$, where T

represents time, in seconds, ℓ represents the
length of the pendulum, in feet, and g equals
32 ft/sec^2. How is this equation expressed
in logarithmic form?

[A] $\log T = \log 2 + \log \pi + \dfrac{1}{2}\log \ell - \log 16$

[B] $\log T = \log 2 + \log \pi + \dfrac{1}{2}\log \ell - \dfrac{1}{2}\log 32$

[C] $\log T = 2 + \log \pi + \dfrac{1}{2}\log \ell - 16$

[D] $\log T = \log 2 + \log \pi + \log \sqrt{\ell - 32}$

10. 080710b, P.I. A.G.4
Which type of function could be used to
model the data shown in the accompanying
graph?

[A] linear   [B] quadratic
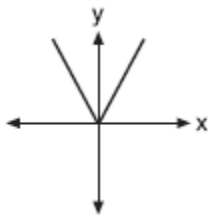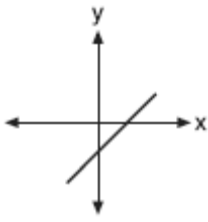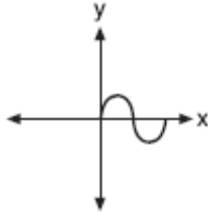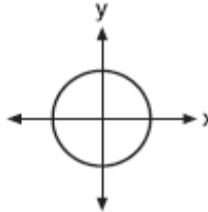
[C] trigonometric   [D] exponential

11. 080711b, P.I. G.G.58
Under a dilation with respect to the origin, the
image of $P(-15,6)$ is $P'(-5,2)$. What is the
constant of dilation?

[A] -4 [B] $\dfrac{1}{3}$ [C] 3   [D] 10

12. 080712b, P.I. A2.A.44
Which graph has an inverse that is a function?

[A]   [B]

[C]   [D]

13. 080713b, P.I. A2.A.4

What is the solution set of the inequality $x^2 + 4x - 5 < 0$?

[A] $\{x | x < -5 \text{ or } x > 1\}$

[B] $\{x | x < -1 \text{ or } x > 5\}$

[C] $\{x | -1 < x < 5\}$ [D] $\{x | -5 < x < 1\}$

14. 080714b, P.I. A.G.4

The graph of which function is symmetric with respect to the graph of the line $y = x$?

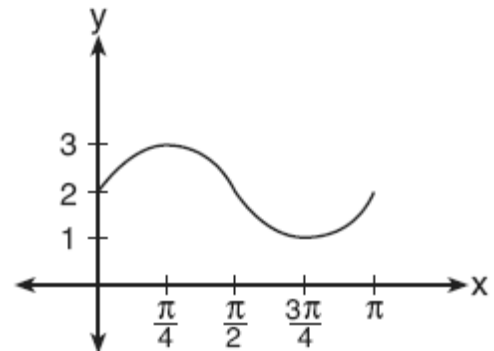[A] $y = \dfrac{1}{x}$ [B] $y = x^3$

[C] $y = x^2$ [D] $y = \log x$

15. 080715b, P.I. G.G.61

The coordinates of $\triangle JRB$ are $J(1,-2)$, $R(-3,6)$, and $B(4,5)$. What are the coordinates of the vertices of its image after the transformation $T_{2,-1} \circ r_{y-\text{axis}}$?

[A] (3,1), (-1,-7), (6,-6)

[B] (-1,-2), (3,6), (-4,5)

[C] (3,-3), (-1,5), (6,4)

[D] (1,-3), (5,5), (-2,4)

16. 080716b, P.I. A2.N.5

The expression $\dfrac{2}{1-\sqrt{3}}$ is equivalent to

[A] $1-\sqrt{3}$ [B] $1+\sqrt{3}$

[C] $-1-\sqrt{3}$ [D] $-1+\sqrt{3}$

17. 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] $y = \sin 2x$

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

18. 080718b

Which equation has the complex number $4 - 3i$ as a root?

[A] $x^2 - 6x + 25 = 0$ [B] $x^2 - 8x + 25 = 0$

[C] $x^2 + 8x - 25 = 0$ [D] $x^2 + 6x - 25 = 0$

19. 080719b, P.I. G.G.53

In the accompanying diagram, $\overrightarrow{PA}$ is tangent to circle O at A, $\overline{PBC}$ is a secant, $PB = 4$, and $BC = 8$.
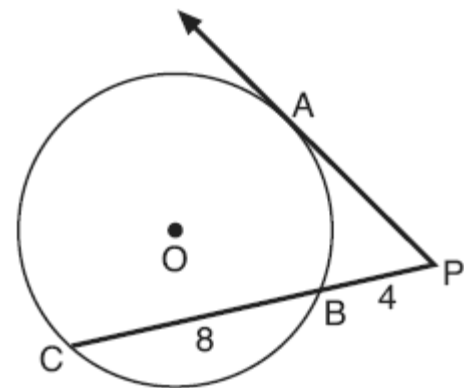
What is the length of $\overline{PA}$?

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

20. 080720b, P.I. A2.A.28

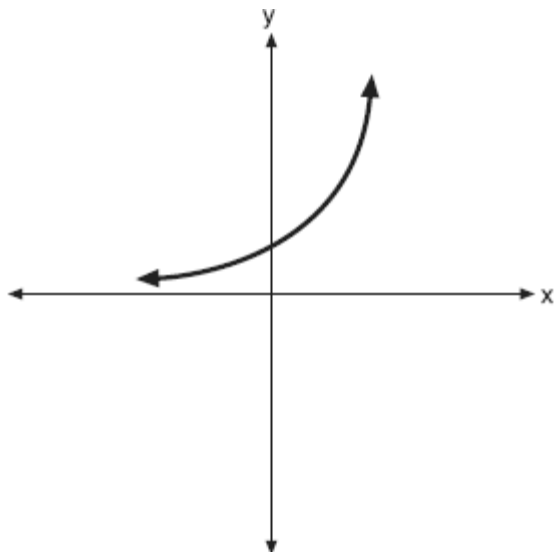If $\log_2 a = \log_3 a$, what is the value of a?

[A] 1   [B] 4   [C] 2   [D] 3

21. 080721b, P.I. A2.A.46

The graph of the function $f(x) = a^x$ is shown on the accompanying set of axes. On the same set of axes, sketch the reflection of $f(x)$ in the y-axis. State the coordinates of the point where the graphs intersect.


22. 080722b, P.I. A.A.26

Solve for all values of x: $\dfrac{2}{x+1} = x$

23. 080723b, P.I. A2.S.15

Mr. and Mrs. Doran have a genetic history such that the probability that a child being born to them with a certain trait is $\dfrac{1}{8}$. If they have four children, what is the probability that *exactly* three of their four children will have that trait?

24. 080724b, P.I. A.N.3

Classical mathematics uses the term "Golden Ratio" for the ratio $(1+\sqrt{5}):2$. The Golden Ratio was used by many famous artists to determine the dimensions of their paintings. If the ratio of the length to the width of a painting is $(1+\sqrt{5}):2$, find the length, in feet, of a painting that has a width of 14 feet. Express your answer in simplest radical form.

25. 080725b, P.I. A.A.23

The slant height, ℓ, of the conical water tank shown in the accompanying diagram is $\ell = \sqrt[3]{\dfrac{8v}{\pi}}$. Solve for v, in terms of ℓ and π.
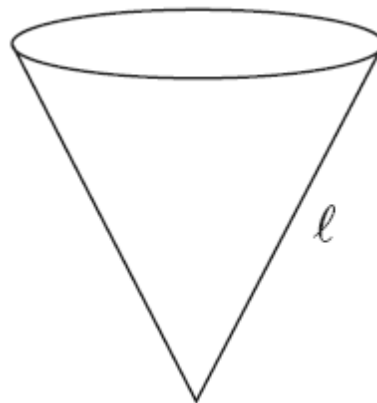
26. 080726b, P.I. G.G.48

The accompanying diagram shows ramp $\overline{RA}$ leading to level platform $\overline{AM}$, forming an angle of 45° with level ground. If platform $\overline{AM}$ measures 2 feet and is 6 feet above the ground, explain why the exact length of ramp $\overline{RA}$ is $6\sqrt{2}$ feet.
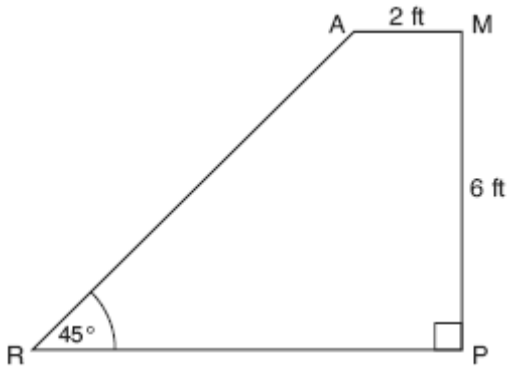
27. 080727b, P.I. A2.A.25

A rectangular patio measuring 6 meters by 8 meters is to be increased in size to an area measuring 150 square meters. If both the width and the length are to be increased by the same amount, what is the number of meters, to the *nearest tenth*, that the dimensions will be increased?

28. 080728b, P.I. A2.S.7

The accompanying table shows the percent of the adult population that married before age 25 in several different years. Using the year as the independent variable, find the linear regression equation. Round the regression coefficients to the *nearest hundredth*. Using the equation found above, estimate the percent of the adult population in the year 2009 that will marry before age 25, and round to the *nearest tenth of a percent*.

Year (*x*)	Percent (*y*)
1971	42.4
1976	37.4
1980	37.1
1984	34.1
1989	32.1
1993	28.8
1997	25.7
2000	25.5

29. 080729b, P.I. A2.A.27

Drew's parents invested $1,500 in an account such that the value of the investment doubles every seven years. The value of the investment, V, is determined by the equation $V = 1500(2)^{\frac{t}{7}}$, where t represents the number of years since the money was deposited. How many years, to the *nearest tenth of a year*, will it take the value of the investment to reach $1,000,000?

30. 080730b, P.I. A2.S.4

Mr. Koziol has 17 students in his high school golf club. Each student played one round of golf. The summarized scores of the students are listed in the accompanying table.

Score	Frequency
70	4
73	3
75	2
80	3
85	1
86	1
90	2
92	1

Find the population standard deviation of this set of students' scores, to the *nearest tenth*. How many of the individual students' golf scores fall within one population standard deviation of the mean?

31. 080731b, P.I. G.G.27

The accompanying diagram shows quadrilateral *BRON*, with diagonals $\overline{NR}$ and $\overline{BO}$, which bisect each other at *X*.
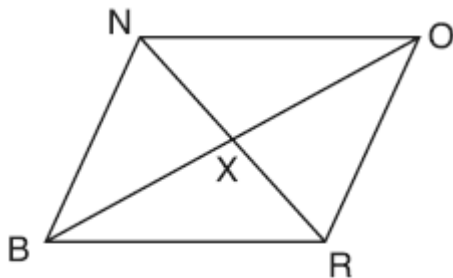
Prove: $\Delta BNX \cong \Delta ORX$

32. 080732b

Two circles whose equations are $(x-3)^2 + (y-5)^2 = 25$ and $(x-7)^2 + (y-5)^2 = 9$ intersect in two points. What is the equation of the line passing through these two points? [The use of the accompanying grid is optional.]
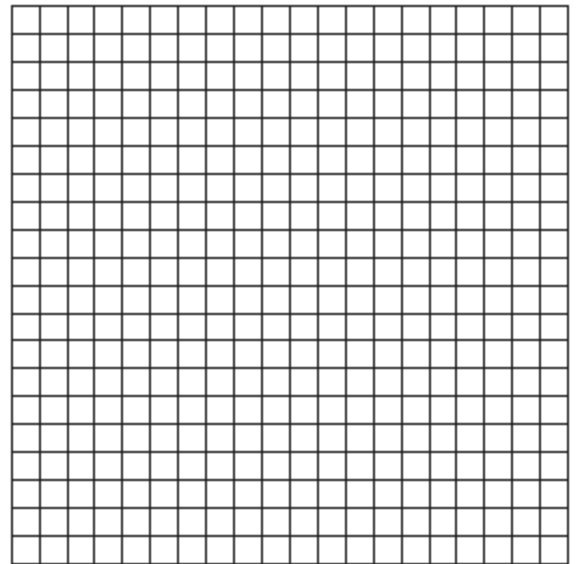
33. 080733b, P.I. A2.A.16

Express in simplest form:

$$\frac{2x}{x^2-4} \div \frac{4}{x^2-4x+4} + \frac{12}{x^2-4} \bullet \frac{2-x}{3}$$

34. 080734b, P.I. A2.A.73

A farmer has a triangular field with sides of 240 feet, 300 feet, and 360 feet. He wants to apply fertilizer to the field. If one 40-pound bag of fertilizer covers 6,000 square feet, how many bags must he buy to cover the field?

[1] D

[2] A

[3] A

[4] A

[5] B

[6] B

[7] C

[8] A

[9] B

[10] D

[11] B

[12] B

[13] D

[14] A

[15] D

[16] C

[17] A

[18] B

[19] C

[20] A

[21] [2] A correct graph is drawn, and the coordinates (0,1) are stated.
[1] One graphing error is made, but appropriate coordinates are stated.
or [1] A correct graph is drawn, but the coordinates of the point of intersection are not stated or are stated incorrectly
or [1] The coordinates (0,1) are stated, but no graph 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.

[22] [2] 1 and -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] Appropriate work is shown, but only one value is found.
or [1] 1 and -2, but no work is shown.
[0] 1 or -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.

[23] [2] $\dfrac{28}{4096}$ or an equivalent answer, and appropriate work is shown, such as evaluating the expression $_4C_3(\dfrac{1}{8})^3(\dfrac{7}{8})^1$.
[1] Appropriate work is shown, but one computational or rounding error is made.
or [1] Appropriate work is shown, but one conceptual error is made.
or [1] The expression $_4C_3(\dfrac{1}{8})^3(\dfrac{7}{8})^1$ is written, but no further correct work is shown.
or [1] $\dfrac{28}{4096}$ or an equivalent answer, but no work is shown.
[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

[2] $7 + 7\sqrt{5}$ and $7(1 + \sqrt{5})$, appropriate work is shown.
[1] Appropriate work is shown, but one computational error is made, or the answer is not expressed in simplest radical form.
or [1] Appropriate work is. shown, but one conceptual error is made.
or [1] $7 + 7\sqrt{5}$ or $7(1 + \sqrt{5})$, 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
[24] incorrect procedure.

[2] $v = \dfrac{\pi \ell^3}{8}$, and appropriate work is shown.
[1] Appropriate work is shown, but one computational error is made.
[1] Appropriate work is shown, but one conceptual error is made.
[1] $v = \dfrac{\pi \ell^3}{8}$, 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
[25] incorrect procedure.

[2] An appropriate explanation is written, such as defining special isosceles right triangles, or appropriate work is shown, such as using legs of six and finding the hypotenuse.
[1] Appropriate work is shown, but one computational error is made.
or [1] Appropriate work is shown, but one conceptual error is made.
[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously
[26] incorrect procedure.

[4] 5.3, and appropriate work is shown, such as solving the equation $(x + 6)(x + 8) = 150$ by using a table or the quadratic formula.
[3] Appropriate work is shown, but one computational or rounding error is made.
or [3] Appropriate solutions are found, but the negative root is not rejected.
[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] The correct quadratic equation in standard form, $x^2 + 14x - 102 = 0$, is written, but no further correct work is shown.
or [1] An incorrect quadratic equation is solved appropriately.
or [1] 5.3, 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
[27] incorrect procedure.

[4] $y = -0.58x + 1185.09$ and 19.9, 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] A correct linear equation is written, but no further correct work is shown.
or [2] An incorrect linear equation is written, but an appropriate percentage is found.
[1] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.
or [1] 19.9, 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
[28] incorrect procedure.

[29] [4] 65.7, and appropriate work is shown.
[3] Appropriate work is shown, but one computational or rounding error is made.
[2] Appropriate work is shown, but two or more computational or rounding errors are made.
or [2] Appropriate work is shown, but one conceptual error is made.
[1] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.
or [1] 65.7, 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] [4] 7.5 and 9, 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, such as using 7.7, the sample standard deviation.
or [2] The population standard deviation and mean are 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] 7.5 and 9, but no work is shown.
[0] 7.5 *or* 9, 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.

[31] [4] A complete and correct proof that includes a concluding statement is written.
[3] A proof is written that demonstrates a thorough understanding of the method of proof and contains no conceptual errors, but one statement or reason is missing or is incorrect or the concluding statement is missing.
[2] A proof is written that demonstrates a good understanding of the method of proof, but one conceptual error is made.
[1] Some correct relevant statements about the proof are made, but two or three statements and/or reasons are missing or are incorrect.
[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.

[4] $x = 7$, and appropriate algebraic work is shown or a correct sketch of the graph of the circles is drawn.
[3] Appropriate work is shown, but one computational or graphing error is made, but an appropriate equation is written.
or [3] The two points of intersection are correctly identified, but the equation is missing or is incorrect.
[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.
or [2] Both circles are graphed correctly, 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] One circle is graphed correctly, but no further correct work is shown.
or [1] $x = 7$, but no work or sketch is shown.
[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously
[32]   incorrect procedure.

[6] $\dfrac{x-4}{2}$, and appropriate work is shown.
[5] Appropriate work is shown, but one computational error is made.
[4] Appropriate work is shown, but two or more computational errors are made.
or [4] Appropriate work is shown, but -1 is not factored out.
[3] Appropriate work is shown, but one conceptual error is made, such as not following the correct order of operations.
[2] Appropriate work is shown, but one conceptual error and one computational error are made.
[1] Appropriate work is shown, but one conceptual error and two or more computational errors are made.
or [1] Appropriate work is shown, but two conceptual errors are made.
or [1] $\dfrac{x-4}{2}$, 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
[33]   incorrect procedure.

[6] 6, and appropriate work is shown, such as determining the area of the field, using Heron's formula or using the Law of Cosines to determine one angle of the triangle, followed by $A = \dfrac{1}{2}ab\sin C,$ and then $A \div 6000.$

[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 to find the area of the triangle, but the number of bags of fertilizer is not found.

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

or [3] The Law of Cosines is used to find an angle, and substitution is made into the correct area equation, 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] The Law of Cosines is used to find an angle, but no further correct work is shown.

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

or [1] 6, but no work is shown.

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

[34]   incorrect procedure.