

1. 080501b, P.I. A.A.41

What is the turning point, or vertex, of the parabola whose equation is $y = 3x^2 + 6x - 1$?

- [A] (3,44) [B] (-3,8)
[C] (-1,-4) [D] (1,8)

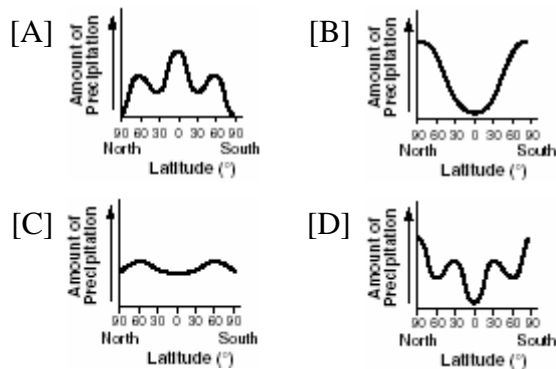
2. 080502b, P.I. A2.A.27

The growth of bacteria in a dish is modeled by the function $f(t) = 2^{\frac{t}{3}}$. For which value of t is $f(t) = 32$?

- [A] 2 [B] 16 [C] 8 [D] 15

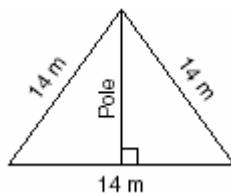
3. 080503b

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



4. 080504b, P.I. G.G.48

The accompanying diagram shows two cables of equal length supporting a pole. Both cables are 14 meters long, and they are anchored to points in the ground that are 14 meters apart.



What is the exact height of the pole, in meters?

- [A] 14 [B] $7\sqrt{2}$ [C] $7\sqrt{3}$ [D] 7

5. 080505b, P.I. A2.A.16

What is the sum of $(y-5) + \frac{3}{y+2}$?

- [A] $\frac{y^2 - 7}{y + 2}$ [B] $\frac{y - 2}{y + 2}$
[C] $y - 5$ [D] $\frac{y^2 - 3y - 7}{y + 2}$

6. 080506b, P.I. A2.N.5

The expression $\frac{1}{5 - \sqrt{13}}$ is equivalent to

- [A] $\frac{5 + \sqrt{13}}{8}$ [B] $\frac{5 + \sqrt{13}}{12}$
[C] $\frac{5 + \sqrt{13}}{-8}$ [D] $\frac{5 + \sqrt{13}}{-12}$

7. 080507b, P.I. A2.N.9

When expressed as a monomial in terms of i , $2\sqrt{-32} - 5\sqrt{-8}$ is equivalent to

- [A] $18i\sqrt{2}$ [B] $-2i\sqrt{2}$
[C] $2i\sqrt{2}$ [D] $2\sqrt{2}i$

8. 080508b, P.I. G.G.54

The image of the origin under a certain translation is the point (2,-6). The image of point (-3,-2) under the same translation is the point

- [A] $(-\frac{3}{2}, \frac{1}{3})$ [B] (-6,12)
[C] (-5,4) [D] (-1,-8)

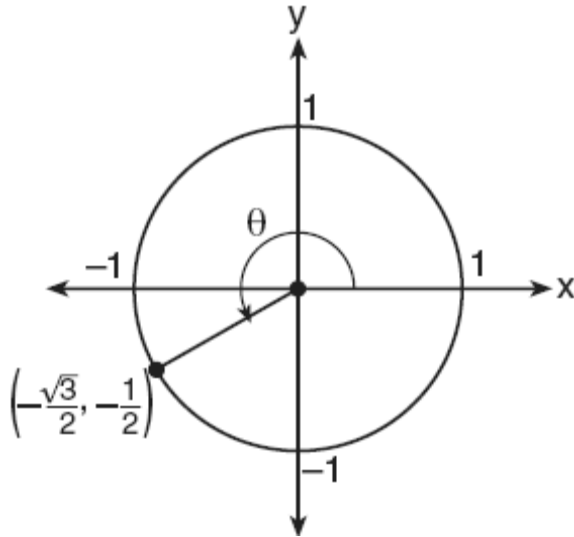
9. 080509b, P.I. A2.A.1

The solution of $|2x - 3| < 5$ is

- [A] $-1 < x < 4$ [B] $x > -1$
[C] $x < -1$ or $x > 4$ [D] $x < 4$

10. 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] 210 [B] 225 [C] 240 [D] 233

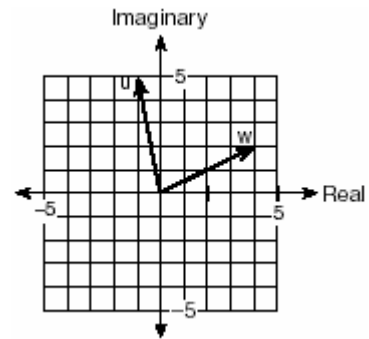
11. 080511b

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

- [A] $-\cos 35^\circ$ [B] $-\cos 55^\circ$
[C] $\cos 55^\circ$ [D] $\cos 35^\circ$

12. 080512b

Two complex numbers are graphed below.



What is the sum of w and u , expressed in standard complex number form?

- [A] $-5 + 3i$ [B] $3 + 7i$
[C] $5 + 7i$ [D] $7 + 3i$

13. 080513b, P.I. A2.A.17

When simplified, the complex fraction

$$1 + \frac{1}{\frac{x}{1-x}}, x \neq 0, \text{ is equivalent to}$$

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

14. 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] 2π [B] 2 [C] 5 [D] π

15. 080515b, P.I. A2.S.5

The mean score on a normally distributed exam is 42 with a standard deviation of 12.1. Which score would be expected to occur less than 5% of the time?

- [A] 32 [B] 25 [C] 60 [D] 67

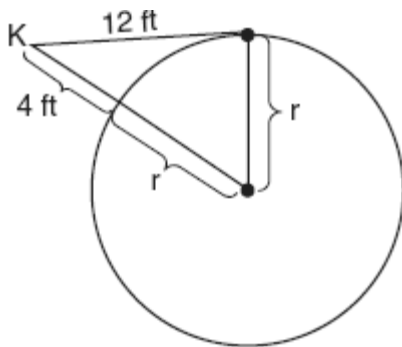
16. 080516b, P.I. A2.A.2
For which positive value of m will the equation $4x^2 + mx + 9 = 0$ have roots that are real, equal, and rational?

[A] 9 [B] 3 [C] 12 [D] 4

17. 080517b
An object orbiting a planet travels in a path represented by the equation $3(y+1)^2 + 5(x+4)^2 = 15$. In which type of pattern does the object travel?

[A] ellipse [B] parabola
[C] circle [D] hyperbola

18. 080518b, P.I. G.G.50
Kimi wants to determine the radius of a circular pool without getting wet. She is located at point K , which is 4 feet from the pool and 12 feet from the point of tangency, as shown in the accompanying diagram.



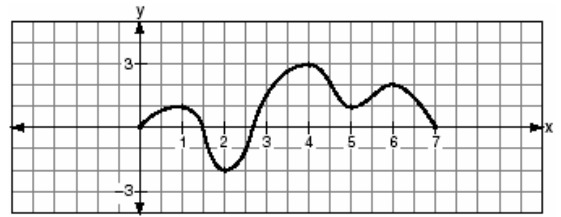
What is the radius of the pool?

[A] 20 ft [B] 32 ft
[C] 16 ft [D] $4\sqrt{10}$ ft

19. 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] 2 [B] 3 [C] 1 [D] 0

20. 080520b, P.I. A2.A.42
The accompanying graph is a sketch of the function $y = f(x)$ over the interval $0 \leq x \leq 7$.



What is the value of $(f \circ f)(6)$?

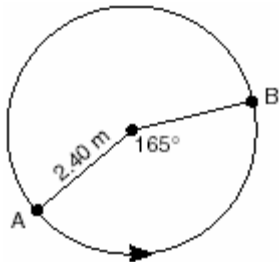
[A] 1 [B] 0 [C] -2 [D] 2

21. 080521b, P.I. A2.N.10
Evaluate: $\sum_{n=1}^5 (n^2 + n)$

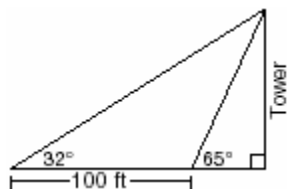
22. 080522b, P.I. A2.S.15
The Coolidge family's favorite television channels are 3, 6, 7, 10, 11, and 13. If the Coolidge family selects a favorite channel at random to view each night, what is the probability that they choose *exactly* three even-numbered channels in five nights? Express your answer as a fraction or as a decimal rounded to *four decimal places*.

23. 080523b, P.I. A2.A.5
Boyle's Law states that the pressure of compressed gas is inversely proportional to its volume. The pressure of a certain sample of a gas is 16 kilopascals when its volume is 1,800 liters. What is the pressure, in kilopascals, when its volume is 900 liters?

24. 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*?

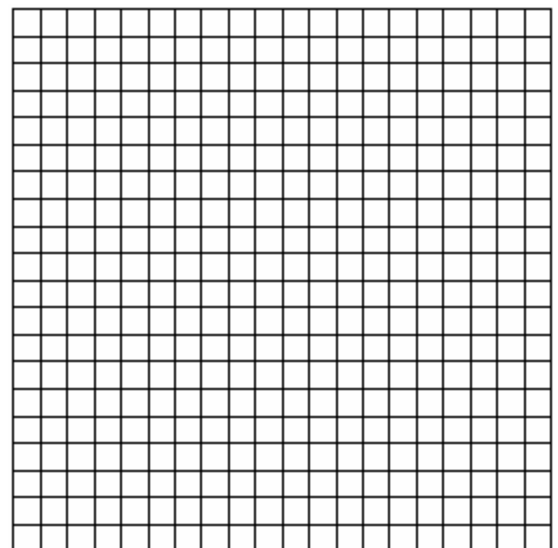


25. 080525b
Given the function $y = f(x)$, such that the entire graph of the function lies above the x -axis. Explain why the equation $f(x) = 0$ has no real solutions.
26. 080526b, P.I. A2.A.67
Express in simplest terms: $\frac{2 - 2 \sin^2 x}{\cos x}$
27. 080527b, P.I. A2.A.73
The accompanying diagram 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*.



28. 080528b, P.I. A2.A.22
The lateral surface area of a right circular cone, s , is represented by the equation $s = \pi r \sqrt{r^2 + h^2}$, where r is the radius of the circular base and h is the height of the cone. If the lateral surface area of a large funnel is 236.64 square centimeters and its radius is 4.75 centimeters, find its height, to the *nearest hundredth of a centimeter*.

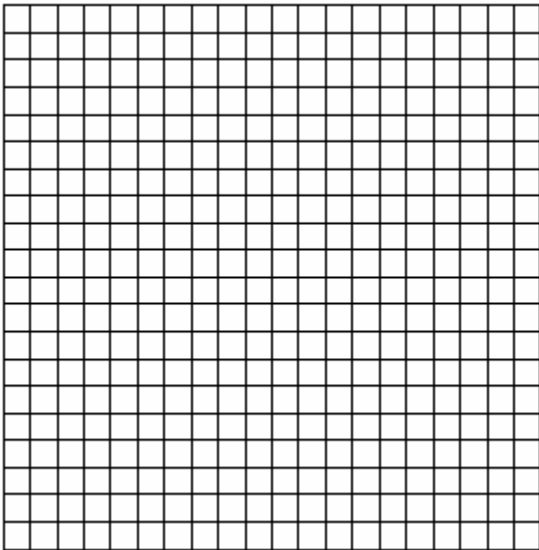
29. 080529b, P.I. A2.A.23
Solve for all values of x : $\frac{9}{x} + \frac{9}{x-2} = 12$
30. 080530b, P.I. A2.A.28
A hotel finds that its total annual revenue and the number of rooms occupied daily by guests can best be modeled by the function $R = 3 \log(n^2 + 10n)$, $n > 0$, where R is the total annual revenue, in millions of dollars, and n is the number of rooms occupied daily by guests. The hotel needs an annual revenue of \$12 million to be profitable. Graph the function on the accompanying grid over the interval $0 < n \leq 100$. Calculate the minimum number of rooms that must be occupied daily to be profitable.



31. 080531b, P.I. A2.A.4

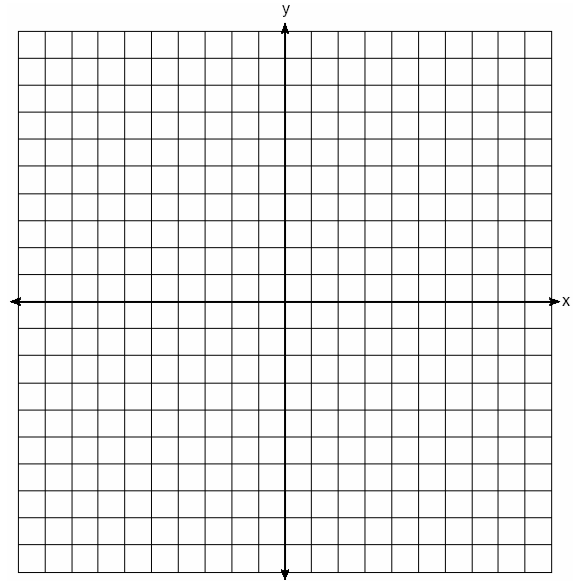
The profit, P , for manufacturing a wireless device is given by the equation

$P = -10x^2 + 750x - 9,000$, where x is the selling price, in dollars, for each wireless device. What range of selling prices allows the manufacturer to make a profit on this wireless device? [The use of the grid is optional.]



32. 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 $-\pi \leq x \leq \pi$. Express, in terms of π , the interval for which $4\cos x \geq 2$.



33. 080533b, P.I. A2.S.7

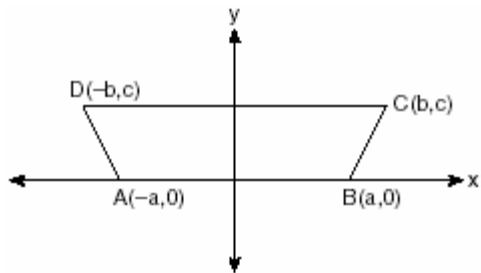
The accompanying table illustrates the number of movie theaters showing a popular film and the film's weekly gross earnings, in millions of dollars.

Number of Theaters (x)	Gross Earnings (y) (millions of dollars)
443	2.57
455	2.65
493	3.73
530	4.05
569	4.76
657	4.76
723	5.15
1,064	9.35

Write the linear regression equation for this set of data, rounding values to *five decimal places*. Using this linear regression equation, find the approximate gross earnings, in millions of dollars, generated by 610 theaters. Round your answer to *two decimal places*. Find the minimum number of theaters that would generate at least 7.65 million dollars in gross earnings in one week.

34. 080534b, P.I. G.G.27

In the accompanying diagram of $ABCD$, where $a \neq b$, prove $ABCD$ is an isosceles trapezoid.



- [1] C
- [2] D
- [3] B
- [4] C
- [5] D
- [6] B
- [7] B
- [8] D
- [9] A
- [10] A
- [11] B
- [12] B
- [13] B
- [14] D
- [15] D
- [16] C
- [17] A
- [18] C
- [19] A
- [20] C

[2] 70, 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] The values for $n = 1$ through $n = 5$ are computed correctly, but they are not added.
or [1] 70, 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

[21] incorrect procedure.

[2] $\frac{40}{243}$ or an equivalent fraction or .1646,
and appropriate work is shown, such as
 ${}_5C_3\left(\frac{1}{3}\right)^3\left(\frac{2}{3}\right)^2$.

[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 finding the probability of choosing at least three even-numbered channels.

or [1] $\frac{40}{243}$ or an equivalent fraction or .1646,

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

[22] incorrect procedure.

[2] 32, and appropriate work is shown.

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

or [1] Only the constant of variation, 28,800, is found.

or [1] 32, but no work is shown.

[0] Direct variation is used.

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

[23] obviously incorrect procedure.

[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

[24] incorrect procedure.

[2] A complete and correct explanation is written, such as stating that since the graph lies entirely above the x -axis, there is no point on the graph where $y = 0$.

[1] An incomplete or partially correct explanation is written, such as stating that the equation has imaginary roots.

[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] $2 \cos x$, 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

[26] incorrect procedure.

[4] 88, and appropriate work is shown, such as $\frac{y}{\sin 32} = \frac{100}{\sin 33}$ 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

[27] incorrect procedure.

[4] 15.13, and appropriate work is shown, such as solving the equation

$$236.64 = \pi(4.75)\sqrt{(4.75)^2 + h^2}.$$

[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] Correct substitution of values is made into the equation, but no further correct work is shown.

or [1] 15.13, 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.

- [4] $15 < x < 60$, and appropriate work is shown, such as solving the algebraic inequality $-10x^2 + 750x - 9000 > 0$ or a graphic solution.
- [3] Appropriate work is shown, but one computational or graphing error is made.
- [3] $15 \leq x \leq 60$, and appropriate work is shown.
- [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 solving the equation $-10x^2 + 750x - 9000 > 0$ for 15 and 60.
- or [2] An incorrect inequality of equal difficulty is solved appropriately.
- [1] Appropriate work is shown, but one conceptual error and one computational or graphing error are made.
- or [1] $15 < x < 60$, but no work is shown.
- [0] $15 \leq x \leq 60$, 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.
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- [31]
- [4] Both equations are graphed correctly over the specified domain and the interval $-\frac{\pi}{3} \leq x \leq \frac{\pi}{3}$ 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 $-1.0472 \leq x \leq 1.0472$ or $-60^\circ \leq x \leq 60^\circ$ 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] $-\frac{\pi}{3} \leq x \leq \frac{\pi}{3}$, 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 $-60^\circ < x < 60^\circ$ 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.
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- [32]

- [6] $y = 0.01021x - 1.66787$, 4.56, and 913, and appropriate work is shown.
- [5] Appropriate work is shown, but one computational or rounding error is made.
- or [5] The expression $0.01021x - 1.66787$ is written and 4.56 and 913 are found, and appropriate work is shown.
- [4] Appropriate work is shown, but two or more computational or rounding errors are made.
- or [4] A correct equation is written, but either the gross earnings or the number of theaters is not found, but appropriate work is shown.
- or [4] An incorrect equation of equal difficulty is written, but appropriate answers are found, and appropriate work is shown.
- [3] Appropriate work is shown, but one conceptual error is made.
- or [3] $y = 0.01021x - 1.66787$, 4.56, and 913, but no work is shown.
- or [3] The expression $0.01021x - 1.66787$ is written and either 4.56 or 913 is found, and appropriate work is shown.
- [2] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.
- or [2] A correct equation is written, but no further correct work is shown.
- [1] 4.56 and 913, but no work is shown.
- or [1] The expression $0.01021x - 1.66787$ is written, but no further correct work is shown.
- [0] Either 4.56 or 913, 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.
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- [33]

- [6] A complete and correct proof that includes a concluding statement is written, such as showing that \overline{AB} is parallel to \overline{CD} and that \overline{BC} is not parallel to \overline{AD} by finding their slopes and using the distance formula to show that the two nonparallel sides are equal.
- [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 one conceptual error is made, such as using an incorrect formula.
- or [4] The slopes of all four sides are found correctly and the lengths of \overline{AD} and \overline{BC} are found correctly, and appropriate work is shown, but no conclusion is stated.
- or [4] A proof is written that correctly shows $ABCD$ is a trapezoid, but it is not proved to be isosceles.
- [3] The slopes of only one pair of sides are found correctly, but the lengths of \overline{AD} and \overline{BC} are found correctly, and appropriate work is shown, and an appropriate conclusion is stated.
- or [3] A correct numerical illustration is given in lieu of a proof of the general case.
- [2] The slopes of only one pair of sides are found correctly, but the lengths of \overline{AD} and \overline{BC} are found correctly, and appropriate work is shown, but no conclusion is stated.
- [1] Either the slopes or the lengths of \overline{AD} and \overline{BC} are found correctly, but no conclusion is stated.
- or [1] The correct definition of an isosceles trapezoid is written, but no further correct work is shown.
- [0] The slopes of \overline{AB} and \overline{DC} are found correctly, but no further correct work is shown.
- [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
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- [34]