Remember:

- The practice test can give you a good indication of how you may perform on an actual test, but there is no guarantee that your results will be the same as on the actual test.
- The actual test looks and operates differently than this practice test. In addition, this test includes one or more assignments that allow you to handwrite and scan your responses. Review the Testing Tutorials and Demonstrations (../../PageView.aspx?f=HTML_FRAG/GENRB_CBTTutorials.html) for more information about the actual test platform.
- A scientific calculator ⬛ (../Docs/calculator_tutorial.pdf) and formulas ⬛ (../Docs/MTEL_63_Formulas.pdf) are provided on-screen with your actual test.

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1. The owner of a T-shirt shop bought a shipment of shirts, each for the same cost, and sold the shirts in the shop for 20% above cost. At the end of the season, not all the shirts had been sold. The owner sold the remaining shirts for the sale price of buy one and get the second shirt for half price, resulting in a loss on the sale of each of these shirts. The loss per shirt for these remaining shirts was what percentage of the owner's original cost per shirt?

   A. 5%

   B. 10%

   C. 20%

   D. 25%

---

2. The resistance, R, in ohms, of a wire is given by the formula $R = \dfrac{\rho \cdot \ell}{A}$, where ρ is the resistivity of the material used to make the wire, ℓ is the length of the wire, and A is its cross-sectional area. What is the resistance of a wire for which $\rho = 1.75 \times 10^{-6}$ ohm·cm, $\ell = 250$ cm, and $A = 3.5 \times 10^{-3}$ cm^2 ?

   A. 1.25×10^{-7} ohms

   B. 1.25×10^{-1} ohms

   C. 1.25×10^{1} ohms

   D. 1.25×10^{4} ohms

---

3. A community group is organizing a dinner. Local florists will donate 128 carnations, 160 lilies, and 16 dozen roses to be put into floral arrangements for the tables. All the arrangements will be identical and all the flowers will be used. In order to create the greatest number of arrangements possible, how many flowers will be in each arrangement?

A. 15 flowers

B. 16 flowers

C. 30 flowers

D. 32 flowers

---

4. **Use the computation below to answer the question that follows.**

$$\begin{array}{r} cd \\ d\overline{)bae} \\ -be \\ \hline ce \\ -cd \\ \hline b \end{array}$$

The letters a, b, c, d, and e represent the specific digits of the numbers involved in the long division computation above. The letters a, b, c, d, and e are not variables.

Which of the following equations correctly represents this computation?

A. bae ÷ d = cd.b

B. bae ÷ d = cd + b

C. bae ÷ d = cd $\dfrac{b}{d}$

D. bae ÷ d = cd $\dfrac{b}{bae}$

---

5. Which of the following values is the best approximation for the area of a rectangle with length ($\sqrt{3}$ + $\sqrt{5}$) inches and width $\sqrt{3}$ inches?

A. 5 square inches

B. 6 square inches

C. 7 square inches

D. 8 square inches

---

6. If x is a positive real number, which of the following expressions is equivalent to $\dfrac{\sqrt[3]{27x} \cdot \sqrt[4]{16x}}{\sqrt{25x}}$?

A. $\dfrac{6 \cdot \sqrt[6]{x}}{5}$

B. $\dfrac{36 \cdot \sqrt[6]{x}}{5}$

C. $\dfrac{6 \cdot \sqrt[12]{x}}{5}$

D. $\dfrac{36 \cdot \sqrt[12]{x}}{5}$

7.   **Use the information below to answer the question that follows.**

> **de Moivre's theorem:**
>
> If $z = r(\cos \theta + i \sin \theta)$, then $z^n = r^n(\cos n\theta + i \sin n\theta)$

According to de Moivre's theorem, what is the value of z^6 if $z = -1 + i$?

        A. −8

        B. −8i

        C. 8

        D. 8i

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8.   **Use the sequence below to answer the question that follows.**

> <u>The Mandelbrot Sequence</u>
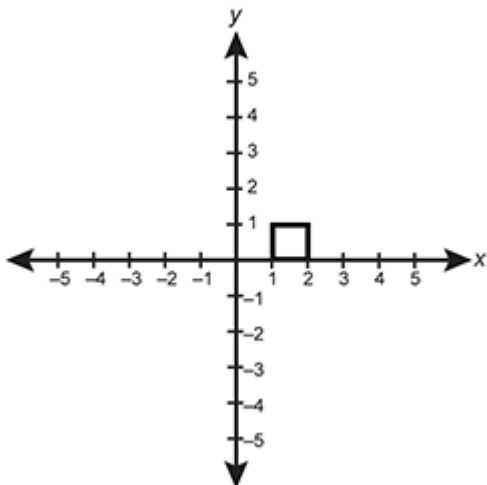>
> 1st term: c
> 2nd term: $c^2 + c$
> 3rd term: $(c^2 + c)^2 + c$
> 4th term: $[(c^2 + c)^2 + c]^2 + c$

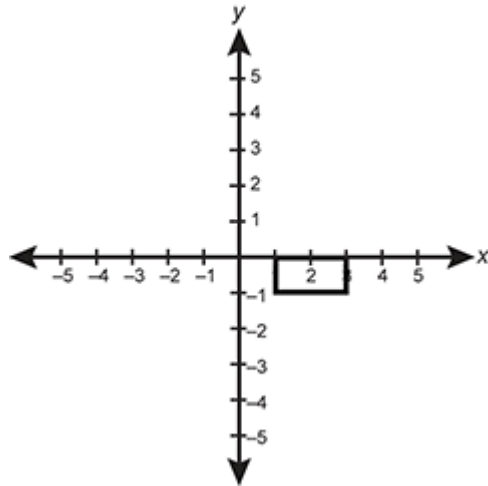When $c = i$, how many of the first four terms of this sequence have a nonzero real part?

        A. 1

        B. 2

        C. 3

        D. 4

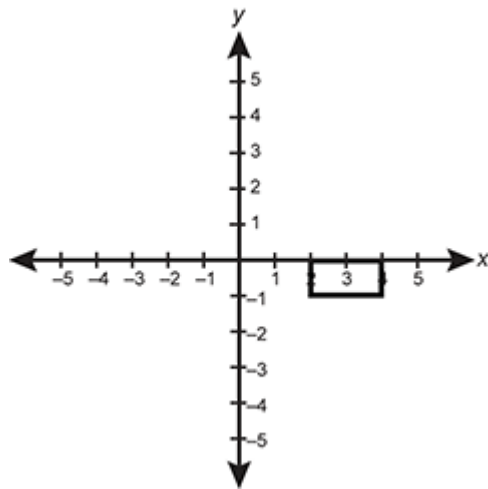9.   **Use the graph below to answer the question that follows.**

Which of the following graphs results from using the linear transformation matrix $\begin{bmatrix} 2 & 0 \\ 0 & -1 \end{bmatrix}$ on the graph above?
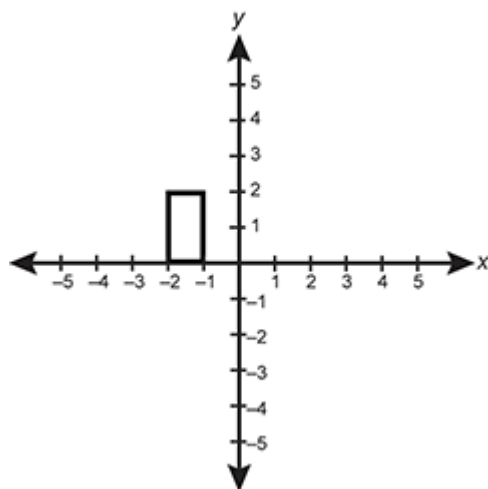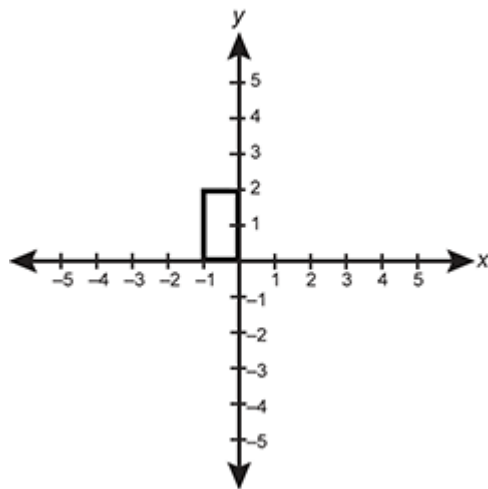
A.

B.

C.

D.

---

10.   A boat starts from a dock located at the point (0, 0) and travels in the direction of the point (3, 4) at 25 miles per hour for 2 hours. Then the boat heads straight toward an island located at the point (50, 48). If each unit represents 1 mile, which of the following vectors represents the direction of the boat when it heads toward the island?

            A. (1, 1)

            B. (5, 2)

            C. (10, 11)

            D. (11, 10)

11.   **Use the matrices below to answer the question that follows.**

Matrix *A* represents the numbers of breakfasts, lunches, and dinners served on each of five consecutive days. Matrix *B* represents the cost of each breakfast, lunch, and dinner. Which of the following is represented by the product of matrix *A* and matrix *B*?

            A. the total costs of all meals combined for each day

            B. the total costs for each type of meal on each day

            C. the total costs for each type of meal for the entire five days

            D. the total cost of all meals combined for the entire five days

---

12.   **Use the diagram below to answer the question that follows.**
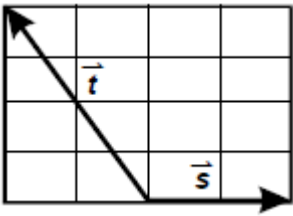
Which of the following vectors represents $\vec{t} + \vec{s}$?

A.

B.

C.

D.
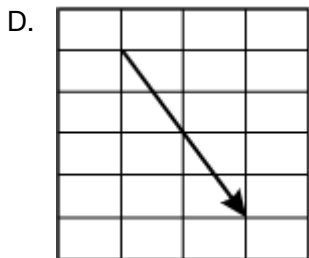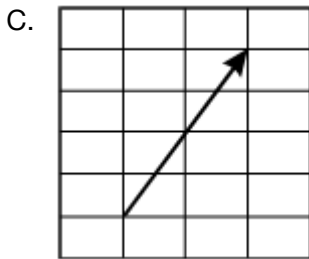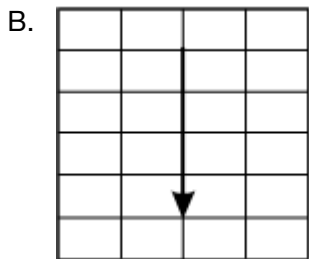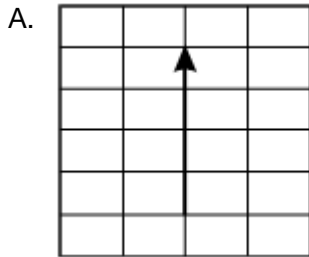
13.

Given that $x > 1$, which of the following expressions is equivalent to $\dfrac{x^{-1} - x}{x^{-2} - x^2}$?

A. $\dfrac{1}{1 + x^2}$

B. $\dfrac{x}{1 + x^2}$

C. $\dfrac{x^2 - 1}{x}$

D. $\dfrac{x^2 + 1}{x}$

---

14. As part of a service project, a high school student organizes a dance show to raise money for a local charity. Youth tickets, *Y,* sell for $6 each and adult tickets, *A,* sell for $9 each. Which of the following algebraic sentences represents the student's goal of collecting at least $1800 in ticket sales?

    A. $A \geq -\dfrac{2}{3}Y + 200$

    B. $A \geq -\dfrac{3}{2}Y + 300$

    C. $A \geq -6Y + 200$

    D. $A \geq -9Y + 300$

---

15. **Use the partially completed two-column proof below to answer the question that follows.**

Given: a real number *a* where $a \neq 0$ and $a^2 = a$
Prove: $a = 1$

Statement	Reason
1. $a \neq 0$ $a^2 = a$	1. Given
2. $a^2 = a \cdot a$	2. Definition of squaring
3. $a \cdot a = a$	3. Substitution property of equality
4. $(a \cdot a) \cdot \dfrac{1}{a} = a \cdot \dfrac{1}{a}$	4. Multiplication property of equality
5. $a \cdot \left(a \cdot \dfrac{1}{a} \right) = a \cdot \dfrac{1}{a}$	5.
6. $a \cdot 1 = 1$	6. Multiplicative inverse property
7. $a = 1$	7. Multiplicative identity property

Which property is the missing reason in step 5?

    A. Commutative property

    B. Associative property

    C. Distributive property

    D. Transitive property

16. Given $ax^2 + bx + c = 0$, which of the following equations is a step in solving for x by completing the square?

A. $x^2 + \dfrac{b}{a}x + \dfrac{b^2}{4a^2} = \dfrac{-c}{a} + \dfrac{b^2}{4a^2}$

B. $x^2 + \dfrac{b}{a}x + \dfrac{b^2}{a^2} = \dfrac{-c}{a} + \dfrac{b^2}{a^2}$

C. $x^2 + \dfrac{b}{a}x + \dfrac{b^2}{4a^2} = -c + \dfrac{b^2}{4a^2}$

D. $x^2 + \dfrac{b}{a}x + \dfrac{b^2}{a^2} = -c + \dfrac{b^2}{a^2}$

17. A polynomial with real coefficients, $P(x)$, is degree 4 and has roots that include -2 and $3 + i$. Which of the following expressions *must* be a quadratic factor of $P(x)$?

A. $x^2 - 4$

B. $x^2 + 4x + 4$

C. $x^2 - 6x - 8$

D. $x^2 - 6x + 10$

18. The solution to which of the following inequalities is $\{x: x < -11 \text{ or } x > 5\}$?
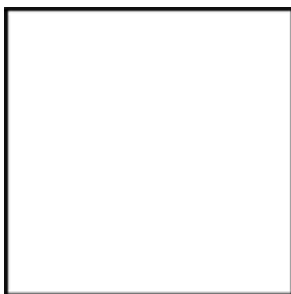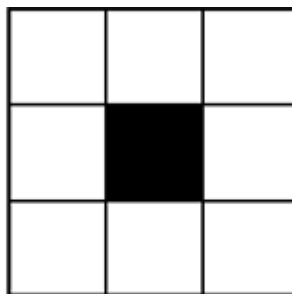
A. $x^2 + 6x - 55 > 0$

B. $x^2 + 6x - 55 < 0$

C. $x^2 - 6x - 55 > 0$

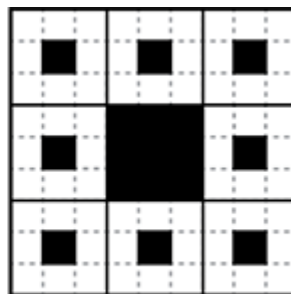D. $x^2 - 6x - 55 < 0$

19. **Use the diagram below to answer the question that follows.**

Original   Stage 1   Stage 2

A square is divided into 9 congruent squares and the center square is shaded, as shown in the diagram. Then, each of the unshaded squares is divided into 9 congruent squares and the center square is shaded. If this process continues, which of the following expressions represents the fraction of the original square that will be shaded?

A. $\dfrac{1}{9} + \left(\dfrac{1}{9}\right)^2 + \left(\dfrac{1}{9}\right)^3 + \left(\dfrac{1}{9}\right)^4 + \ldots$

B. $\dfrac{1}{9} + 8 \cdot \left(\dfrac{1}{9}\right) + 8^2 \cdot \left(\dfrac{1}{9}\right) + 8^3 \cdot \left(\dfrac{1}{9}\right) + 8^4 \cdot \left(\dfrac{1}{9}\right) + \ldots$

C. $\dfrac{1}{9} + 8 \cdot \left(\dfrac{1}{9}\right)^2 + 8^2 \cdot \left(\dfrac{1}{9}\right)^3 + 8^3 \cdot \left(\dfrac{1}{9}\right)^4 + \ldots$

D. $\dfrac{1}{9} + 9 \cdot \left(\dfrac{1}{9}\right)^2 + 9 \cdot \left(\dfrac{1}{9}\right)^3 + 9 \cdot \left(\dfrac{1}{9}\right)^4$

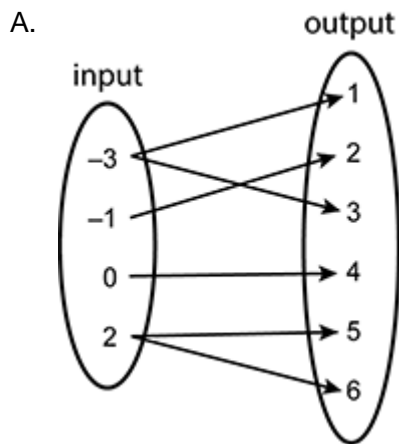20.   **Use the graph below to answer the question that follows.**
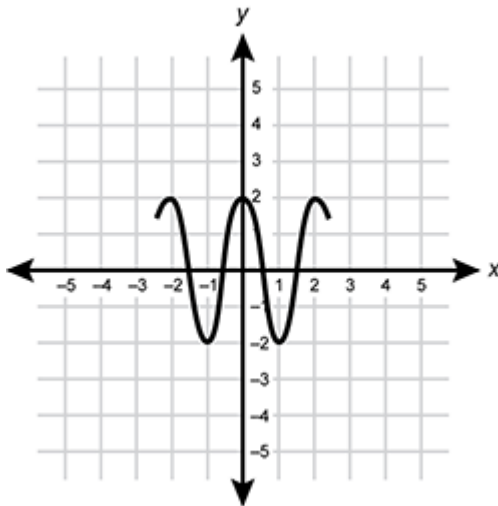
The graph shows a periodic function $f(x)$ that has a domain of all real numbers. If the pattern continues for the entire domain, the value of the function at $x = \dfrac{35}{2}$ is the same as the value of the function at:

A. $x = \dfrac{1}{3}$.

B. $x = 1$.

C. $x = \dfrac{3}{2}$.

D. $x = 2$.

21.   Which of the following relations is a function?

A.

B. {(4, 2), (9, 3), (4, −2), (25, −5)}

C.
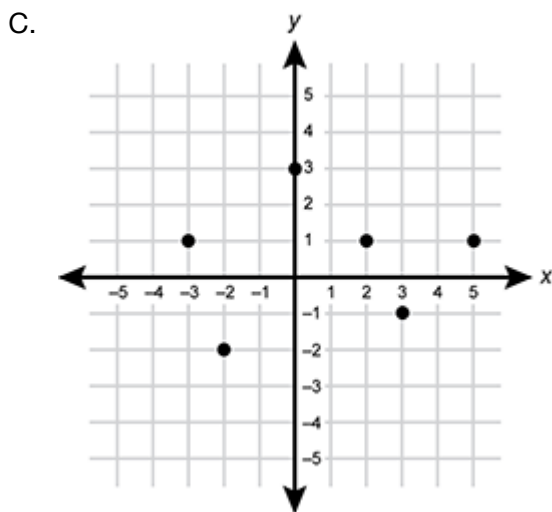
D. {(x, y): $y^2 = x + 1$}

---

22. Given the functions $f(x) = x^2 + 2x + 5$, $g(x) = \sqrt{x}$, and $h(x) = g(f(x))$, which of the following statements describes the range of $h(x)$?

    A. $h(x) \geq 0$

    B. $h(x) \geq 2$

    C. $h(x) \geq \sqrt{5}$

    D. $h(x)$ is any real number.

---

23. Which of the following statements correctly relates a function $f(x)$ and its inverse, $f^{-1}(x)$?

    A. If $f(x) = x + 2$, then $f^{-1}(x) = 2 - x$.

    B. If $f(x) = x^2$, then $f^{-1}(x) = 2^x$.

    C. If $f^{-1}(x)$ is the inverse of $f(x)$, then $f(f^{-1}(x)) = f^{-1}(f(x)) = x$.

    D. If $f^{-1}(x)$ is the inverse of $f(x)$, then $f(f^{-1}(x)) = f^{-1}(f(x)) = 1$.

24.

The set $\{a_n\}$ represents an arithmetic sequence. If $a_8 = \dfrac{41}{2}$ and $a_{16} = \dfrac{81}{2}$, which of the following recursive formulas represents $\{a_n\}$?

A. $a_1 = 0$

$a_n = \dfrac{5}{2} a_{n-1} + \dfrac{1}{2}$

B. $a_1 = \dfrac{1}{2}$

$a_n = a_{n-1} + \dfrac{5}{2}$

C. $a_1 = 0$

$a_n = \dfrac{5}{2} a_{n-1} + 3$

D. $a_1 = 3$

$a_n = a_{n-1} + \dfrac{5}{2}$

25.

It costs a company $10,620 to manufacture 20 units of a certain air conditioner. It costs the company $14,940 to manufacture 30 units. Assuming that the data fit a linear function, how much will it cost the company to manufacture 36 units?

A. $15,552

B. $17,532

C. $18,126

D. $18,522

26.

For what values of m will the graphs of $y = mx + 3$ and $y = -x^2 + 3x + 2$ have no points of intersection?

A. $-5 < m < -1$

B. $1 < m < 5$

C. $m < -5$ or $m > -1$

D. $m < 1$ or $m > 5$

27.

An absolute value function of the form $y = |x + b| + c$ passes through the points (–6, 13) and (16, 15). What is the location of the vertex for this function?

A. (0, 7)

B. (4, 3)

C. (5, 14)

D. (8, 23)

28. **Use the function below to answer the question that follows.**

$f(x) = 2x^2 - 24x + 6$

What is the maximum value of $f(x)$ on the interval $-3 \le x \le 5$?

    A. 176

    B. 96

    C. −64

    D. −66

---

29. **Use the inequalities below to answer the question that follows.**

$2x + y \ge 0$
$x - y < 1$

Which of the following graphs shows the solution to the system of linear inequalities?

A.
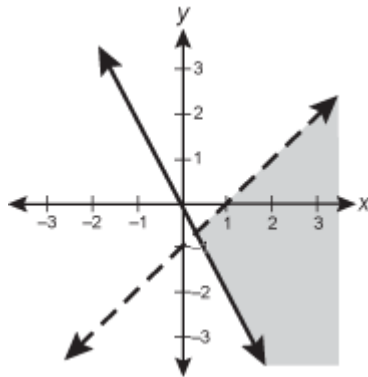
B.
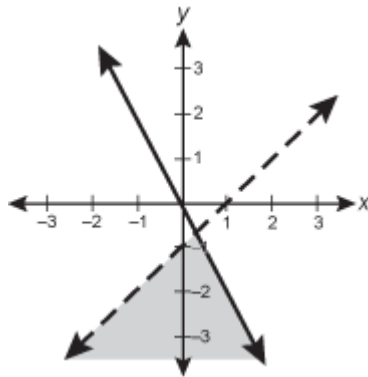
C.
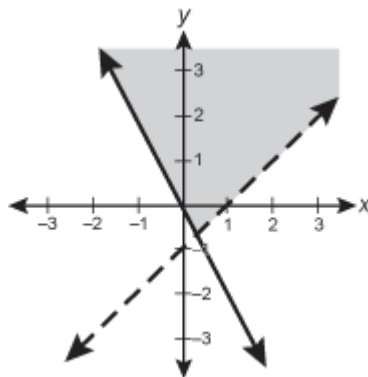
D.

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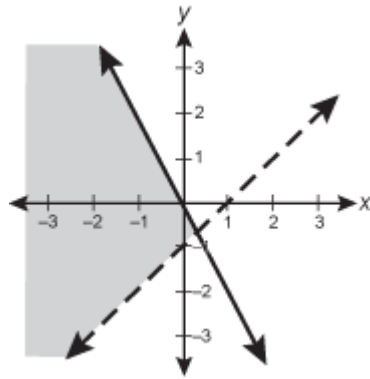
30.   **Use the table below to answer the question that follows.**

Production Parameters per 1,000

product type	profit (dollars)	prep time (hours)	bake time (hours)
bagels (*b*)	60	2	3
pretzels (*p*)	50	4	1

The manager of a commercial bakery uses the table above to optimize the profitability of the bakery. The bakery's preparation room can operate for up to 16 hours per day and its baking facility can run for up to 12 hours per day. If *b* represents thousands of bagels and *p* represents thousands of pretzels, which of the following graphs represents the linear programming problem?

A.

B.

C.

D.

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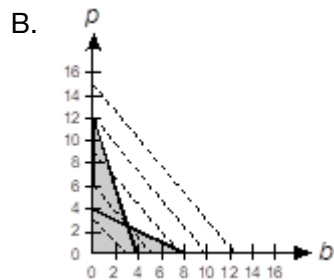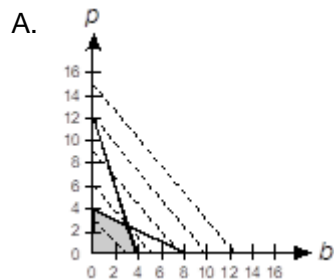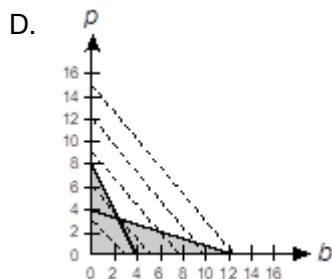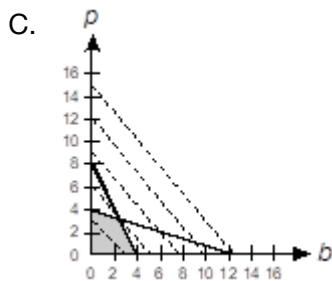
31.   A construction company purchases a piece of equipment for $42,000 that decreases in value at the rate of 6% per year. Which of the following equations represents its value at the end of n years?

        A. $V_n = 42{,}000(0.94)^n$

        B. $V_n = 42{,}000(0.94n)$

        C. $V_n = 42{,}000 - 42{,}000(0.06)^n$

        D. $V_n = 42{,}000 - 42{,}000(0.06n)$

---

32.   The points $\left(-2, \dfrac{27}{4}\right)$ and $(0, 3)$ lie on the graph of an exponential function. What number is the base of this function?

        A. $\dfrac{2}{\sqrt{15}}$

        B. $\dfrac{2}{3}$

        C. $\dfrac{\sqrt{15}}{2}$

        D. $\dfrac{3}{2}$

---

33.   If $f(x) = 2^{1-x}$, which of the following graphs could represent its inverse, $f^{-1}(x)$?

A.

(2, 0)

B.

(0, 2)

C.

(−2, 0)

D.

(0, –2)
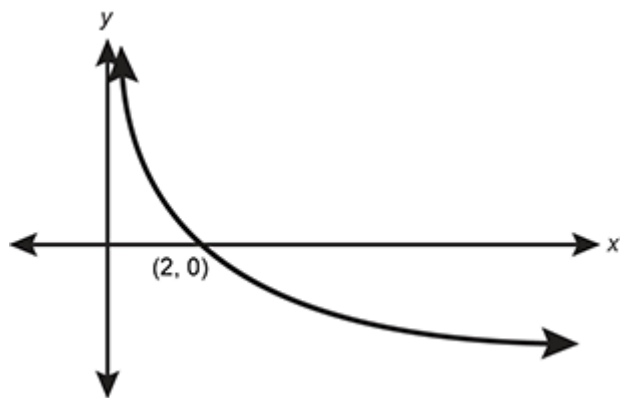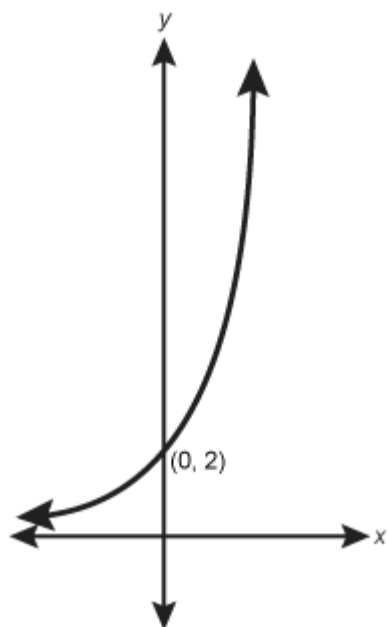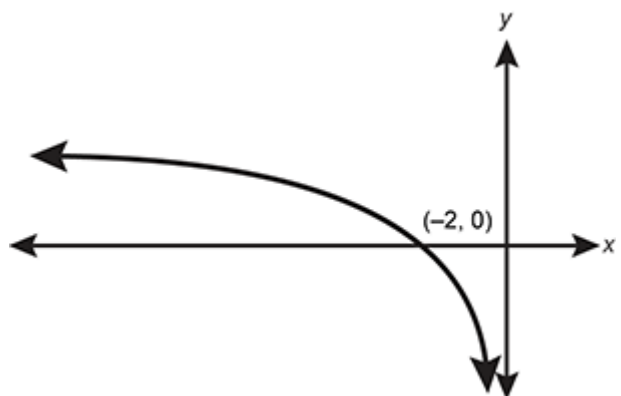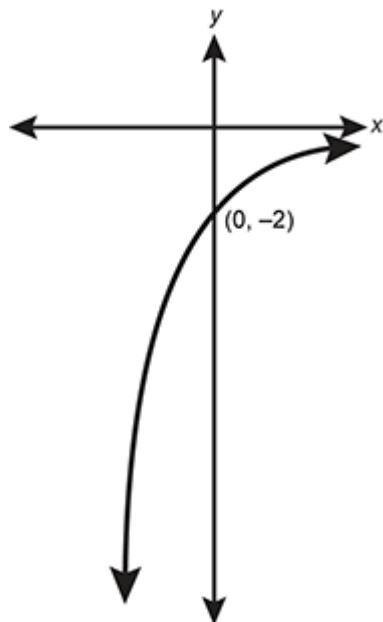
34. Which of the following statements describes intercepts and asymptotes of the function $f(x) = \log_4(x + 2)$?

   A. It has intercepts (–1, 0) and $\left(0, \dfrac{1}{2}\right)$, and an asymptote at $x = -2$.

   B. It has intercepts (–1, 0) and (0, –2), and an asymptote at $x = -2$.

   C. It has intercepts (–2, 0) and $\left(0, \dfrac{1}{2}\right)$, and an asymptote at $x = 2$.

   D. It has intercepts (–2, 0) and (0, –2), and an asymptote at $x = 2$.

35. Which of the following equations could be a step in solving the equation $\dfrac{\log_2(x - 1)}{5} = 1$ for x?

   A. $x - 1 = 5^2$

   B. $2^{x-1} = 5$

   C. $x - 1 = 2^5$

   D. $5^{x-1} = 2$

36. If $f(x) = 3(2^x)$ and $g(x) = \log_2\left(\dfrac{1}{3}x\right)$, what is $f(g(x))$?

   A. 1

   B. x

   C. $6^{\frac{x}{3}}$

   D. $3 \cdot 2^{\frac{x}{3}}$

37. A person invests $10,000 at a 5% annual interest rate compounded quarterly. Solving which of the following equations yields t, the doubling time in years?

        A. $e^{0.0125t} = 2$

        B. $e^{0.05t} = 2$

        C. $(1.0125)^{4t} = 2$

        D. $(1.05)^{4t} = 2$

38. Which of the following graphs best represents the rational function $f(x) = \dfrac{1}{x-2} + 2$?

A.

B.

C.
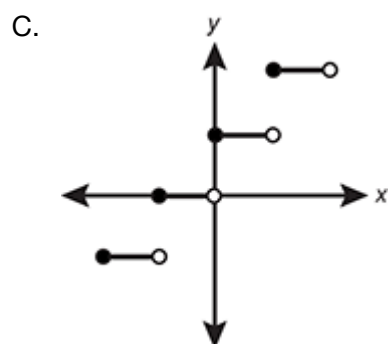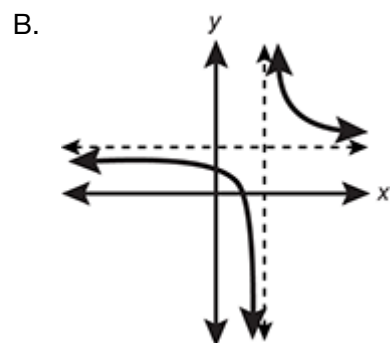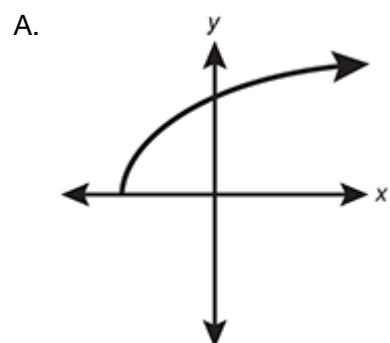
D.

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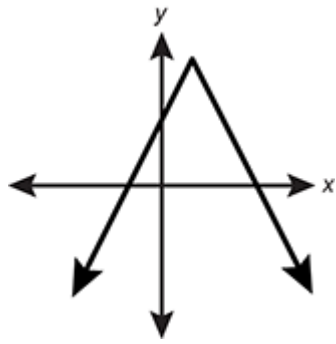
39. Let $f(x) = x^3 - a^2x$, where a is a positive real number. Which of the following is a true statement about the graph of $f(x)$?

   A. $y = -x$ is a line of symmetry of $f(x)$.

   B. $f(x)$ has exactly two real roots.

   C. $y = x - a$ is a slant asymptote of $f(x)$.

   D. $f(x)$ has exactly two critical points.

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40. **Use the graph below to answer the question that follows.**
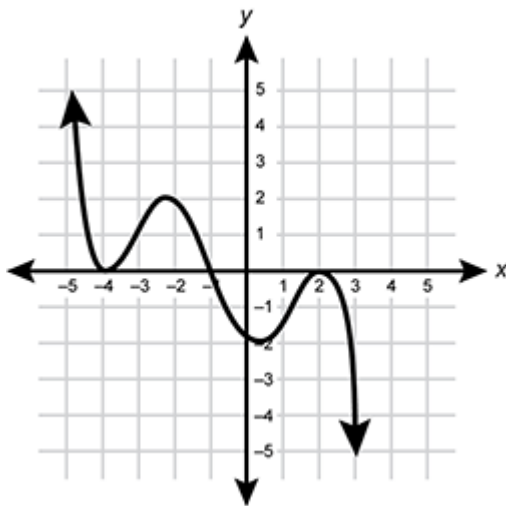
Which of the following polynomial functions could be represented by the graph?

   A. $P(x) = -0.03(x - 4)(x - 1)(x + 2)$

   B. $P(x) = -0.03(x + 4)(x + 1)(x - 2)$

   C. $P(x) = -0.03(x - 4)^2(x - 1)(x + 2)^2$

   D. $P(x) = -0.03(x + 4)^2(x + 1)(x - 2)^2$

---

41. The graph of which of the following equations has a vertical asymptote at $x = 2$, a point of discontinuity at $x = -1$, and horizontal asymptote $y = \dfrac{1}{2}$?

A. $y = \dfrac{x + 1}{x^2 - 4x - 4}$

B. $y = \dfrac{x + 1}{2x^2 + 6x + 4}$

C. $y = \dfrac{x^2 - 1}{x^2 + 4x + 4}$

D. $y = \dfrac{x^2 - 1}{2x^2 - 2x - 4}$

---

42. A rectangle is drawn on the coordinate plane so that two of its vertices are on the x-axis and the other two vertices are above the x-axis and on the graph of the function $y = 36 - x^2$. If the coordinates of the rectangle's vertex in the first quadrant are (x, y) and the area of the rectangle is 160 square units, which of the following equations could be solved to find x?

   A. $-12x^2 + 272 = 0$

   B. $-12x^2 + 352 = 0$

   C. $x^3 - 36x + 80 = 0$

   D. $x^3 - 36x + 160 = 0$

---

43. **Use the equation below to answer the question that follows.**

$$\dfrac{x^2 - 2x - 15}{x^2 - 9} = 0$$

Which of the following is the complete solution to the equation above?

   A. $x = \pm 3$

   B. $x = 5$

   C. $x = 5$, or $x = -3$

   D. $x = 5$, or $x = \pm 3$

---

44. **Use the table below to answer the question that follows.**

	$f(2) - f(1)$	$f(3) - f(2)$	$f(4) - f(3)$	$f(5) - f(4)$
$f_1(x)$	1	4	9	16
$f_2(x)$	2	2	2	2
$f_3(x)$	3	5	7	9
$f_4(x)$	4	5	7	10

The table above shows the first differences of four functions. Based on their second differences, which of the following functions is quadratic?

    A. $f_1(x)$

    B. $f_2(x)$

    C. $f_3(x)$

    D. $f_4(x)$

45.

A ray intersecting a unit circle is coincident with the terminal side of an angle of $\dfrac{8\pi}{3}$. Which of the following expressions represents $\sec\left(\dfrac{8\pi}{3}\right)$?

    A. -2

    B. $-\dfrac{1}{2}$

    C. $\dfrac{\sqrt{3}}{2}$

    D. $\dfrac{2\sqrt{3}}{3}$

---

46.   The graph of $y = \sin x$ undergoes a transformation that places the minimum point of the new graph at $\left(\dfrac{11\pi}{6}, -\dfrac{1}{2}\right)$ over the interval $0 \le x \le 2\pi$. If there is no vertical shift or change in period, what are the amplitude and phase shift of the transformed graph?

    A. amplitude $= \dfrac{1}{2}$, phase shift $= \dfrac{\pi}{3}$ to the right

    B. amplitude $= \dfrac{1}{2}$, phase shift $= \dfrac{5\pi}{6}$ to the right

    C. amplitude $= 1$, phase shift $= \dfrac{\pi}{3}$ to the right

    D. amplitude $= 1$, phase shift $= \dfrac{5\pi}{6}$ to the right

---

47.   The average daily temperature T, in degrees Fahrenheit, for a certain city fluctuates from a low of 16° to a high of 80°. January 1 is day 1. The low of T occurs on January 30 (day 30) and the high of T occurs on July 31 (day 212). Assume that the average daily temperature can be modeled over the span of one year by a cosine function where T is the average daily temperature and t is the time in days, with $t = 1$ corresponding to January 1. Which of the following equations models the average daily temperature over one year for this city?

A. $T = 48 \cos\left[\dfrac{2\pi}{365}(t - 212)\right] + 32$

B. $T = 32 \cos\left[\dfrac{2\pi}{365}(t - 212)\right] + 48$

C. $T = 48 \cos\left[\dfrac{365}{2\pi}(t - 212)\right] + 32$

D. $T = 32 \cos\left[\dfrac{365}{2\pi}(t - 212)\right] + 48$

---

48. **Use the equation below to answer the question that follows.**

$\sin^2(2x) = \cos^2(2x)$

What is the difference between the two smallest positive solutions of the equation shown?

- A. $\dfrac{\pi}{6}$

- B. $\dfrac{\pi}{4}$

- C. $\dfrac{\pi}{3}$

- D. $\dfrac{\pi}{2}$

---

49. Which of the following expressions is equivalent to $\dfrac{\tan^2 x}{1 + \tan^2 x}$?

- A. $\cos^2 x$
- B. $\sec^2 x$
- C. $\sin^2 x$
- D. $\csc^2 x$

---

50. Which of the following equations could be a step in verifying the identity $\sin x + \cos x \cdot \cot x = \csc x$?

- A. $\sin^2 x + \sin x \cdot \cos x \cdot \cot x = \csc x$

- B. $\dfrac{\sin^2 x}{\sin x} + \dfrac{\cos^2 x}{\sin x} = \csc x$

- C. $\tan x + \cot x = \dfrac{1}{\sin x}$

- D. $\dfrac{\sin^2 x}{\sin x} + \dfrac{\cot x}{\sin x} = \csc x$

51. A sign has the shape of a regular octagon with side lengths measuring 1 foot. Which of the following expressions represents the area of the sign in square feet?

    A. $2\sqrt{2} + 1$

    B. $4\sqrt{2} + 2$

    C. $2\sqrt{2} + 2$

    D. $4\sqrt{2} + 4$

---

52. **Use the diagram below to answer the question that follows.**
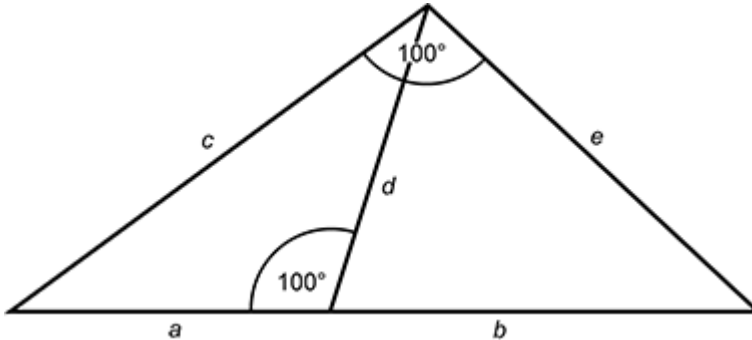
Which of the following equations can be deduced from the diagram?

    A. $cb = ae$

    B. $ad = bd$

    C. $ce = ad + bd$

    D. $cd = ab + b^2$

---

53. **Use the diagram below to answer the question that follows.**
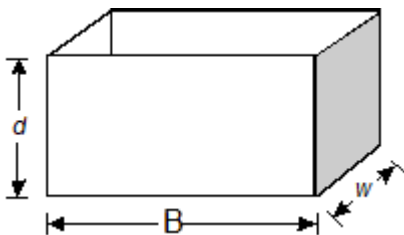
The container above has length B, width w, depth d, and volume V. A new container has a similar design except that the length is quadrupled, the width is doubled, and the depth is cut in half. Which of the following is equivalent to the volume of the new container?

    A. $\dfrac{V}{2}$

    B. V

    C. $4V$

    D. $8V$

54. **Use the diagram below to answer the question that follows.**
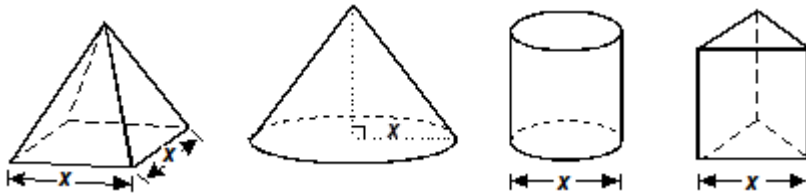
The four solids shown above all have the same height. The square-based pyramid has base side length equal to x. The cone has base radius equal to x. The cylinder has base diameter equal to x. The equilateral triangle-based prism has base side length equal to x. Which solid has the greatest volume?

    A. pyramid

    B. cone

    C. cylinder

    D. prism

---

55. A cylindrical can is measured to have a base radius of 5 cm (centimeters) and a height of 15 cm (centimeters), both rounded to the nearest whole centimeter. The volume of the can is calculated based on these measurements. What is the maximum possible error in the calculated volume of the can?

    A. 232.7 cm (centimeters)^3

    B. 255.6 cm (centimeters)^3

    C. 275.3 cm (centimeters)^3

    D. 294.9 cm (centimeters)^3

---

56. Two distinct angles are drawn on a plane so that one pair of rays are collinear and the other pair are parallel. Which of the following statements describes their relationship?

    A. In all cases, the angles must be congruent.

    B. In all cases, the angles must be supplementary.

    C. Depending on their positions, the angles must be either congruent or supplementary.

    D. Depending on their positions, the angles may be congruent, supplementary, or neither.

---

57. **Use the information below to answer the question that follows.**

> Given isosceles triangle PQR with base $\overline{QR}$, and a point N on $\overline{QR}$ such that N is not the midpoint of $\overline{QR}$, prove that $\overline{PN}$ does not bisect $\angle QPR$.

An indirect proof of the statement shown uses which of the following strategies?

A. Assume that point *N* is the midpoint of $\overline{QR}$ and prove that $\overline{PN}$ bisects ∠*QPR*.

B. Assume that $\overline{PN}$ bisects ∠*QPR* and prove that *N* is the midpoint of $\overline{QR}$.

C. Assume that triangle *PQR* is not isosceles and prove that $\overline{PN}$ bisects ∠*QPR*.

D. Assume that $\overline{PN}$ bisects ∠*QPR* and prove that $\overline{QR}$ cannot be the base of triangle *PQR*.

---

58.   In a regular polygon, the measure of one interior angle is 12° larger than 6 times the measure of one exterior angle. How many sides does this polygon have?

      A. 15

      B. 18

      C. 20

      D. 24

---

59.   A parallelogram is inscribed in a circle. This parallelogram must be a:

      A. rectangle.

      B. square.

      C. rhombus.

      D. kite.

---

60.   **Use the information below to answer the question that follows.**

> **Given:** △*ABC*
>
> **Prove:** Area $= \dfrac{1}{2} (AB)(AC) \sin A$

Given that the area of a triangle is one-half the product of its base and height, which of the following is a true statement regarding the proof asked for above?

A. The area formula can be proven if a height *h* is drawn from *B* to $\overline{AC}$ and $\sin A \dfrac{AB}{h}$ is used.

B. The area formula can be proven if a height *h* is drawn from *B* to $\overline{AC}$ and $\sin A = \sin A \dfrac{h}{AB}$ is used.

C. The area formula is true only for right triangles because $\sin 90° = 1$, and $\overline{AB}$ and $\overline{AC}$ will be the base and height.

D. The area formula is true only if ∠*A* ≤ 90°, since the height drawn to $\overline{AC}$ needs to go through the interior of the triangle in order to use the correct sine ratio.

61.   Students are creating logos that will contain triangles in which they want to inscribe circles. To find the centers of these circles, the students should construct the three:

    A. altitudes of each triangle.

    B. medians of each triangle.

    C. angle bisectors of each triangle.

    D. perpendicular bisectors of the sides of each triangle.

---

62.   Which of the following statements is true in three-dimensional Euclidean space?

    A. If a line is perpendicular to a plane, then it is perpendicular to any line in the plane.

    B. If two lines are each perpendicular to a third line, then they are parallel to each other.

    C. If a line is perpendicular to each of two planes, then the planes are parallel.

    D. If two planes are each perpendicular to the same plane, then they are parallel to each other.

---

63.   **Use the diagram below to answer the question that follows.**
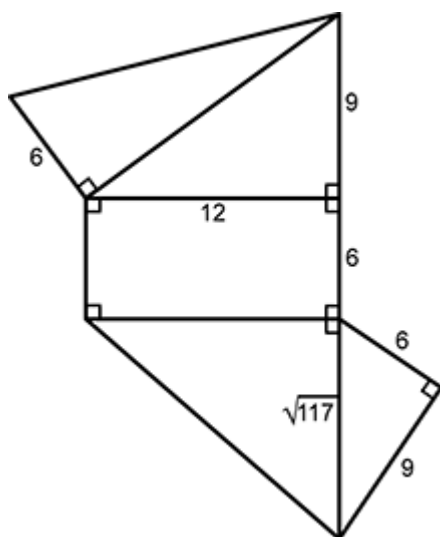
The diagram above represents the net of a three-dimensional solid. What is the volume of the solid?

    A. $12 \sqrt{117}$ cubic units

    B. 216 cubic units

    C. $24 \sqrt{117}$ cubic units

    D. 324 cubic units

---

64.   Points A and B are midpoints of the opposite edges of a single face of a cube. At a 45° angle to this face of the cube, a plane cuts through the cube through points A and B. What is the most descriptive name for the quadrilateral formed on the surface of this cut?

A. parallelogram

B. rhombus

C. rectangle

D. square

---

65.   **Use the diagram below to answer the question that follows.**
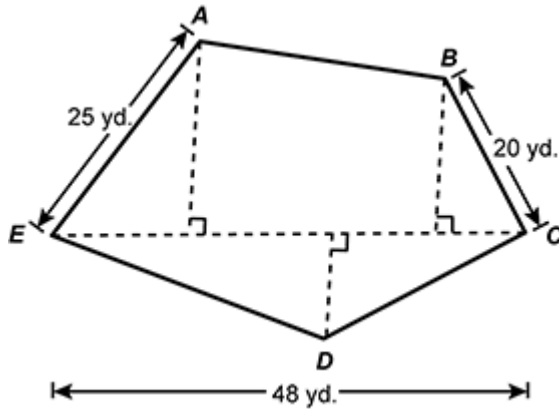
Pentagon *ABCDE* represents an irregular plot of land. The distances from points *A*, *B*, and *D* to diagonal *EC* measure 20 yards, 16 yards, and 10 yards, respectively. The land is to be seeded with grass at the rate of 3 pounds of seed for every 1000 square feet. Approximately how many pounds of grass seed are needed?

    A. 7.8 pounds

    B. 11.2 pounds

    C. 19.7 pounds

    D. 23.3 pounds

---

66.   To determine container size for a product, one measure used by a manufacturer is the packaging efficiency ratio, which is defined as the ratio of the surface area of the container to the volume of the container. The manufacturer currently uses a container that is a cylinder with an efficiency ratio *r*. If a similar cylinder is to be created by multiplying each linear measurement of the existing container by a scale factor of *k*, what will be the efficiency ratio of the new container?

    A. $\dfrac{r}{k}$

    B. kr

    C. $\dfrac{r}{k^3}$

    D. $k^3 r$

---

67.   **Use the diagram below to answer the question that follows.**
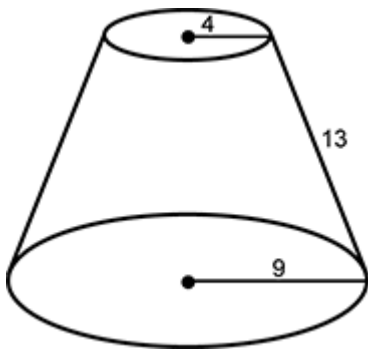
The frustum of a cone is created by cutting off the top of the cone with a slice parallel to the base of the cone, as shown in the diagram. The radii of the parallel faces are 4 units and 9 units. The slant height of the frustum is 13 units. To the nearest tenth of a unit, what is the height of the cone from which this frustum was created?

    A. 16.5 units

    B. 17.3 units

    C. 20.8 units

    D. 21.6 units

---

68.   **Use the equation below to answer the question that follows.**

$x^2 + (y - 4)^2 = 25$

A parabola has x-intercept $(1, 0)$ and the same y-intercepts as the graph of the equation shown. Which of the following equations represents the parabola?

    A. $y = \dfrac{1}{9}(x^2 - 9)$

    B. $y = \dfrac{1}{9}(x^2 - 8x - 9)$

    C. $x = \dfrac{1}{9}(y^2 - 9)$

    D. $x = \dfrac{1}{9}(y^2 - 8y - 9)$

---

69.   What are the x-coordinates of the foci of the ellipse represented by $4x^2 + 9y^2 + 16x - 18y = 11$?

    A. $1 \pm \sqrt{5}$

    B. $1 \pm \sqrt{13}$

    C. $-2 \pm \sqrt{5}$

    D. $-2 \pm \sqrt{13}$

---

70.   Which of the following equations represents the perpendicular bisector of the line segment connecting $A(1, -7)$ to $B(5, 3)$?

A. $2x + 5y = -4$

B. $2x + 5y = 29$

C. $5x + 2y = 11$

D. $5x + 2y = 20$

---

71.   **Use the graph below to answer the question that follows.**
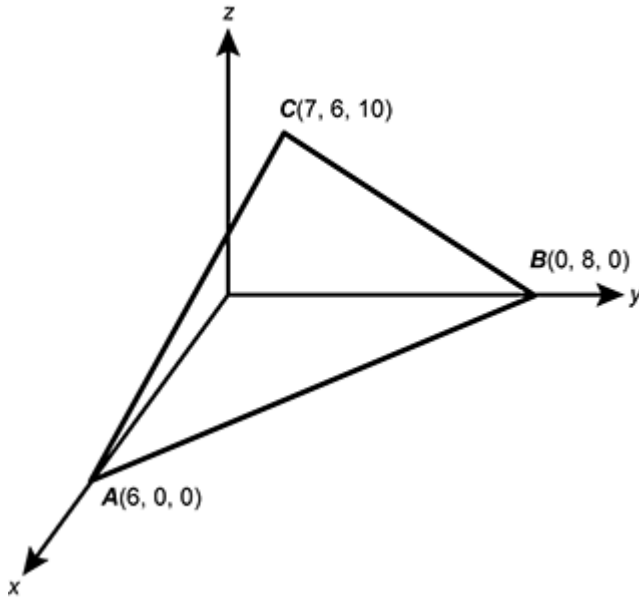
The vertices of a triangle ABC in a three-dimensional coordinate system are $A(6, 0, 0)$, $B(0, 8, 0)$, and $C(7, 6, 10)$. What is the length of the median from point C to side AB?

A. 10

B. $2\sqrt{30}$

C. 16

D. $10\sqrt{3}$

---

72.   Triangle ABC is drawn on a coordinate plane with vertices $A(-6, 8)$, $B(-4, 2)$, and $C(5, 2)$. Triangle ABC undergoes a dilation centered at point C with a scale factor of $\dfrac{4}{3}$ to form triangle $A'B'C'$.

What is the area of triangle $A'B'C'$?

A. 36

B. $12\sqrt{10}$

C. 48

D. $16\sqrt{10}$

---

73.   Which of the following statements is valid in spherical geometry?

A. Through any two points there is exactly one line.

B. When two lines intersect, vertical angles are equal.

C. The sum of the angles of any triangle is equal to 180 degrees.

D. Through a point outside a given line, exactly one line can be drawn that does not intersect the given line.

---

74. **Use the tire tread design below to answer the question that follows.**
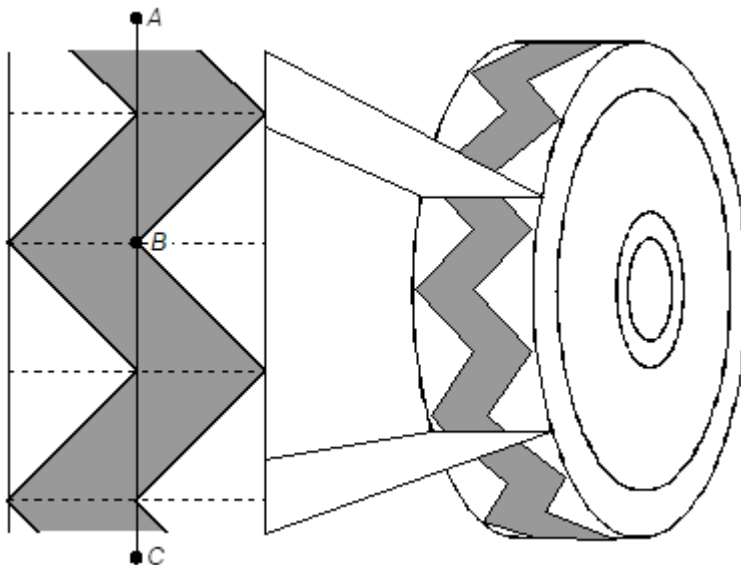
Under which of the following transformations will the design remain unchanged?

    A. dilation with respect to point B

    B. 180° rotation around point B

    C. reflection across $\overline{AC}$

    D. glide-reflection along $\overline{AC}$

---

75. A snack cracker company puts a coupon in each box. Twenty percent of the coupons are for a discount on a particular brand of cheese. Assuming that the distribution of boxes is random among supermarkets, which of the following simulations could be used to determine the average number of boxes a person needs to buy to get a coupon for the cheese?

    A. Use a random number table and assign the number 20 as a success. Read two-digit numbers until a 20 is read. Record the number of numbers read including the last one. Repeat 100 times.

    B. Toss 2 fair coins 10 times. Assign heads as a success and count the number of times exactly 2 heads comes up. Repeat 100 times.

    C. Use a random number table and assign the digits 0 and 1 as successes. Read single digits until a 0 or a 1 is read. Record the number of numbers read including the last one. Repeat 100 times.

    D. Toss a fair coin 5 times. Assign heads as a success and count the number of times heads comes up. Repeat 100 times.

76. What is the probability that any two *real* numbers between 1 and 7 inclusive, selected at random, will have a sum of at least 6?

 A. $\dfrac{2}{9}$

 B. $\dfrac{7}{9}$

 C. $\dfrac{10}{49}$

 D. $\dfrac{39}{49}$

---

77. **Use the diagram below to answer the question that follows.**
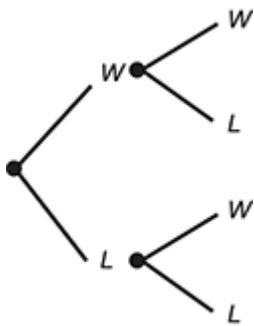
The tree diagram shows the potential results for a soccer team that plays against two opponents and will either win (*W*) or lose (*L*) each game. The probability that the team will win against the first opponent is $\dfrac{1}{3}$, and the probability that the team will win against the second opponent is $\dfrac{1}{5}$. What is the probability that the team will win at least 1 game?

 A. $\dfrac{4}{15}$

 B. $\dfrac{2}{5}$

 C. $\dfrac{7}{15}$

 D. $\dfrac{3}{5}$

---

78. **Use the table below to answer the question that follows.**

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
$40	$50	$20	$20	$20	$50	$100

Each of 150 people purchased one raffle ticket for a weeklong lottery. Each day a ticket is drawn and the person with the winning ticket wins the amount shown in the table for that day. The winning ticket is then returned, so a person can win multiple times in the week. A person calculated the expected value of the winnings on Sunday before the drawing, did not win on the first 5 days, and then calculated the expected value of the winnings on Friday before the drawing. What is the difference in the expected value of the winnings based on these two calculations?

    A. $1.00

    B. $2.00

    C. $10.00

    D. $150.00

---

79.   A band's 20 most popular songs from their previous albums were released on a new greatest hits album. Two songs from the first album appear on the greatest hits album. The songs are played in a random order that allows for repetition. If the probability that the first song played comes from the first album and the second song played comes from the second album is 3%, what fraction of the songs on the greatest hits album come from the band's first two albums?

    A. $\dfrac{3}{10}$

    B. $\dfrac{2}{5}$

    C. $\dfrac{1}{2}$

    D. $\dfrac{4}{5}$

---

80.   In a school system with 10 elementary schools, the school board is considering requiring students to wear school uniforms. The board wants to find out whether the students' caregivers would support this plan. Which of the following sampling methods would result in the **least** sampling bias?

    A. Send a survey home with each student asking caregivers to fill it out and return it within five days.

    B. Randomly select one of the elementary schools and call each student's caregiver, following up until a response is made.

    C. Send an e-mail to a random sample of caregivers asking them to log their responses on the school board's website.

    D. Randomly select 30 caregivers from each school. Send each a survey and follow up with a phone call if they do not return the survey within two weeks.

---

81.   **Use the information below to answer the question that follows.**

0	2 3 5
1	0 0 2 2 5 5 5 5
2	2 5 5 5 6 6 7 8 8
3	0 0 0 0 4

Key: 1 | 3 = 13

The stem-and-leaf plot shows the minutes on "hold" of 25 randomly chosen callers waiting to speak to a representative of a particular company. Which of the following box plots best summarizes these data?

A.

B.

C.

D.

---
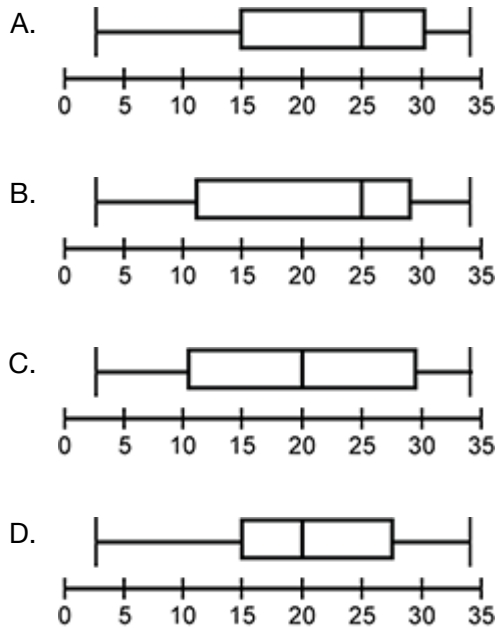
82.   Each of the numbers in a normally distributed data set is multiplied by two. How does this transformation affect the mean, the median, and the shape of the frequency distribution curve?

        A. The mean doubles, but the median and the shape stay the same.

        B. The mean and the median double, and the shape becomes wider.

        C. The median doubles, but the mean and the shape stay the same.

        D. The median and the mean stay the same, but the shape becomes wider.

---

83.   According to which of the following horizontal bar charts was the median number of cars sold per day equal to the mean number of cars sold per day?

A.

	Cars Sold
Fri.	2
Thurs.	4
Wed.	4
Tues.	4
Mon.	2

0 1 2 3 4 5
Cars Sold

B.

	Cars Sold
Fri.	2
Thurs.	3
Wed.	4
Tues.	3
Mon.	2

0 1 2 3 4 5
Cars Sold

C.

	Cars Sold
Fri.	5
Thurs.	4
Wed.	3
Tues.	4
Mon.	5

0 1 2 3 4 5
Cars Sold

D.

	Cars Sold
Fri.	2
Thurs.	4
Wed.	3
Tues.	1
Mon.	

0 1 2 3 4 5
Cars Sold

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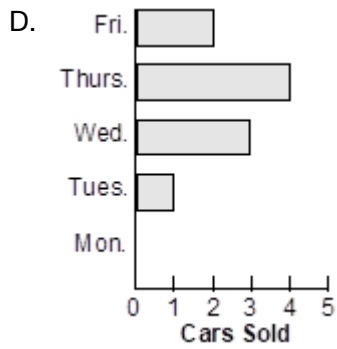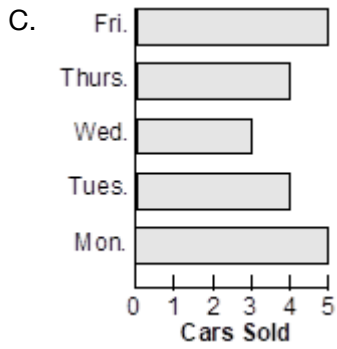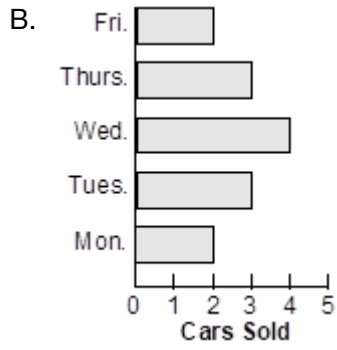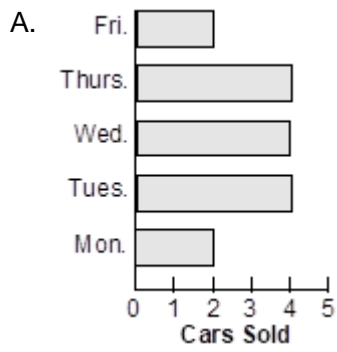
84. **Use the information below to answer the question that follows.**

Linear Regression for Town A	**Linear Regression for Town B**
$y = ax + b$	$y = ax + b$
$a = 0.4694308286$	$a = 3.8574694345$
$b = 7.738425386$	$b = 2.396738264$

Students use a statistics program to study the populations of two towns. They enter twenty years of population data. The population in thousands is represented by y. The year is represented by x. The program generates the above linear regression results. Which of the following conclusions can be reached from these results?

    A. The model for Town A is a better predictor of population than the model for Town B.

    B. The population was initially smaller in Town B than in Town A.

    C. The model for Town A predicted a faster growth rate than the model for Town B.

    D. The population growth rate was accelerating in Town B and decelerating in Town A.

---

85. What is $\lim\limits_{x \to 1} \dfrac{1-x}{x^2-1}$?

    A. $-\dfrac{1}{2}$

    B. 0

    C. 1

    D. Limit does not exist.

86.

Which of the following equations represents the line tangent to $y = (x^2+1)^{\frac{1}{2}}$ at $x = 1$?

    A. $y = \dfrac{\sqrt{2}}{2}x + \dfrac{\sqrt{2}}{2}$

    B. $y = \dfrac{\sqrt{2}}{4}x + \dfrac{3\sqrt{2}}{4}$

    C. $y = \dfrac{\sqrt{2}}{2}x + \dfrac{3\sqrt{2}}{4}$

    D. $y = \dfrac{\sqrt{2}}{4}x + \dfrac{5\sqrt{2}}{4}$

87.

At what value(s) of x, if any, do points of inflection occur on the graph of $f(x) = 3x^{\frac{2}{3}} - 2x$?

    A. $x = -1$

    B. $x = 0$

    C. $x = 1$

    D. There are no points of inflection.

88. When a drop of water falls into a pond, it creates a circular ripple that expands outward at 9 inches per second. What is the approximate instantaneous rate of change of the area enclosed by the circular ripple after 2 seconds?

    A. 1.5 square feet per second

    B. 7.1 square feet per second

    C. 9.4 square feet per second

    D. 18.9 square feet per second

89. Which of the following functions is continuous for all real values of x?

    A. $f(x) = \dfrac{x^2 - 9}{x - 3}$

    B. $f(x) = \dfrac{x^2 - 9}{\sqrt{x - 3}}$

    C. $f(x) = \begin{cases} x^2 + 2 \text{ for } x \le 1 \\ x + 2 \text{ for } x > 1 \end{cases}$

    D. $f(x) = \begin{cases} x + 2 \text{ for } x \le 1 \\ x - 2 \text{ for } x > 1 \end{cases}$

90. Which of the following equations represents the derivative with respect to x for the function $f(x) = (2x^4 + 3)^5$?

    A. $f'(x) = 40x^3(2x^4 + 3)^4$

    B. $f'(x) = 8x^3(2x^4 + 3)^5$

    C. $f'(x) = 5(2x^4 + 3)^4$

    D. $f'(x) = (8x^3 + 3)^5$

91. **Use the graph below to answer the question that follows.**
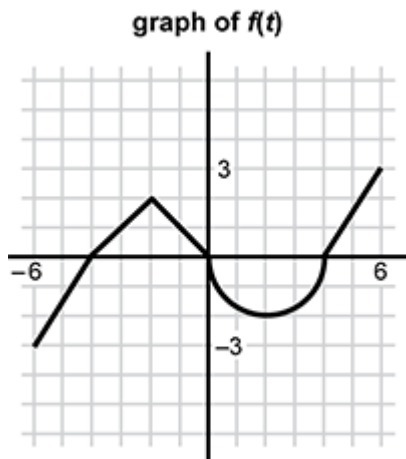
graph of $f(t)$

The graph of a function $f(t)$ is shown on the interval $[-6, 6]$. It consists of line segments and a semicircle. Let $G(x) = \int_{-4}^{x} f(t)\, dt$. Where in the interval $[-6, 6]$ does the graph of $G(x)$ achieve its minimum value?

    A. $x = -6$

    B. $x = -4$

    C. $x = 2$

    D. $x = 4$

92.

The integral $\int_{0}^{1} x^2 \sqrt{x^3 + 1}\, dx$ may be evaluated using the substitution $u = x^3 + 1$. What is the value of this definite integral?

    A. $\dfrac{2}{9}$

    B. $\dfrac{2}{3}$

    C. $\dfrac{2}{9}(2\sqrt{2} - 1)$

    D. $\dfrac{2}{3}(2\sqrt{2} - 1)$

93.

Which of the following expressions represents $\int \dfrac{x^2 - 5}{x^2}\, dx$?

    A. $1 + \dfrac{5}{x} + C$

    B. $x + \dfrac{5}{x} + C$

    C. $1 - \dfrac{15}{x^2} + C$

    D. $x - \dfrac{15}{x^2} + C$

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94.   **Use the graph below to answer the question that follows.**

$h = x(12 - x)$

An architect designs a glass wall that extends from the ground up to a curved metal frame represented by the function $h = x(12 - x)$. In the graph shown, h represents the height of the frame, and the x-axis represents the ground. Both variables are measured in feet. How much glass does the architect need for the wall?

    A. 288 square feet

    B. 339 square feet

    C. 4608 square feet

    D. 5184 square feet

---

95.   **Use the function below to answer the question that follows.**

$c(t) = 1.2e^{0.14t}$

The manager of a new water treatment plant estimates that the plant's capacity will grow according to the function above, where $c(t)$ represents capacity rate in millions of gallons per year and t represents the number of years since the plant opened. Based on this estimate, which of the following approximates the total number of gallons of water that will be treated in the first five years that the plant is open?

    A. 2.4 million gallons

    B. 8.7 million gallons

    C. 9.3 million gallons

    D. 17.3 million gallons

---

96.   A student is using mathematical induction to prove that the sum of the first n odd numbers is n^2. The student demonstrates that the sum is correct when $n = 1$. The student then assumes that it is true for the first k odd numbers and writes $1 + 3 + 5 + 7 + ... + (2k - 1) = k^2$. The student must now show that:

    A. $1 + 3 + 5 + 7 + ... + (2k - 1) + 2k = k^2 + 1$.

    B. $1 + 3 + 5 + 7 + ... + (2k - 1) + 2k = (k + 1)^2$.

    C. $1 + 3 + 5 + 7 + ... + (2k - 1) + (2k + 1) = k^2 + 1$.

    D. $1 + 3 + 5 + 7 + ... + (2k - 1) + (2k + 1) = (k + 1)^2$.

97.   **Use the matrix below to answer the question that follows.**

$$
\begin{array}{c}
\text{to} \\
\begin{array}{cccccc}
 & A & B & C & D & E \\
A & \begin{bmatrix} 0 \\ 1 \\ 0 \\ 1 \\ 1 \end{bmatrix} & \begin{matrix} 1 \\ 0 \\ 1 \\ 0 \\ 0 \end{matrix} & \begin{matrix} 1 \\ 0 \\ 0 \\ 1 \\ 0 \end{matrix} & \begin{matrix} 0 \\ 1 \\ 0 \\ 0 \\ 0 \end{matrix} & \begin{matrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}
\end{array}
\end{array}
$$

from C

The matrix shown models communication between computers A, B, C, D, and E. Communication from one computer to another is given in each row, with a 1 indicating communication and a 0 indicating no communication. Which of the following directed graphs represents this communication network?

A.

B.

C.
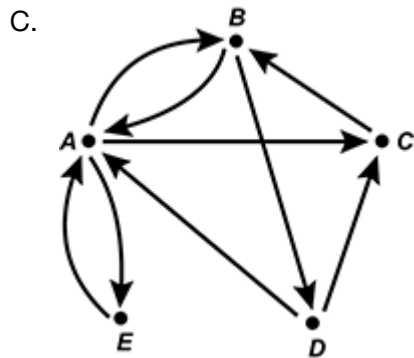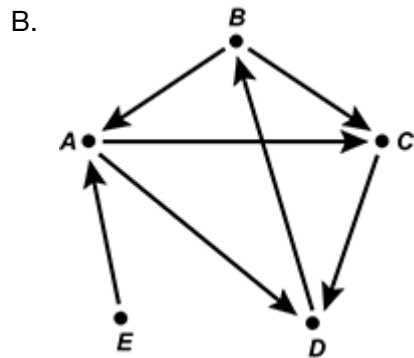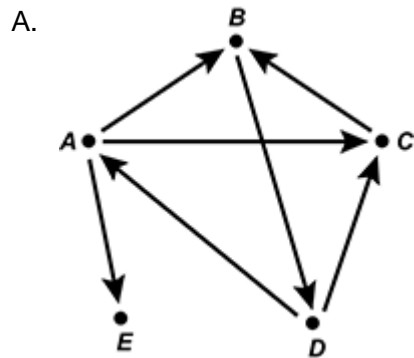
D.

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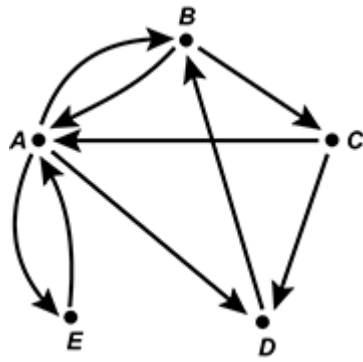
98.   **Use the Venn diagram below to answer the question that follows.**

Of the 212 students in a particular high school, 50 played fall sports, 49 played winter sports, and 48 played spring sports. Eleven played sports in all three seasons, while 20 played only fall sports, 24 played only winter sports, and 16 played only spring sports. Based on this information and the partially completed Venn diagram shown, how many students played no sports in any of the three seasons?
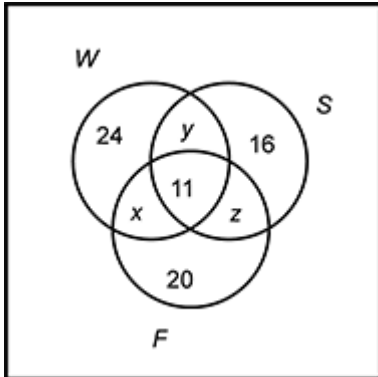
     A. 65 students

     B. 87 students

     C. 114 students

     D. 136 students

---

99.   A television station shows an "adopt a pet" program featuring dogs and cats from a local shelter once each month. Three dogs and three cats will be chosen for today's program. If the shelter has 6 dogs and 8 cats, all equally likely to be chosen, how many different sets of animals could be chosen for the program?

     A. 1,120

     B. 4,480

     C. 10,080

     D. 40,320

100.

In a nature preserve, 2 naturalists must accompany every group of 12 visitors who want to hike the trails in the preserve. One naturalist must be the first person on the trail and the other naturalist must be the last. If the naturalists and the visitors hike single file, in how many different orders may they arrange themselves on the trail?

        A. $12!$

        B. $2 \cdot 12!$

        C. $14!$

        D. $2 \cdot 14!$

Open-Response Items

> The directions shown below represent what you will see on the actual test. For the purposes of this practice test, you will be able to type your written responses in the boxes provided on the answer key.

This section of the test consists of two open-response item assignments. You will be asked to prepare a written response of approximately 150–300 words, or 1–2 pages, for each assignment.

Read the assignments carefully before you begin your responses. Think about how you will organize your responses. You may use the erasable sheet(s) to make notes, write an outline, or otherwise prepare your responses. *However, your final response to each assignment must be either:*

1. typed into the on-screen response box,
2. written on a response sheet and scanned using the scanner provided at your workstation, or
3. provided using both the on-screen response box (for typed text) and a response sheet (for calculations or drawings) that you will scan using the scanner provided at your workstation.

Instructions for scanning your response sheet(s) are available by clicking the "Scanning Help" button at the top of the screen.

As a whole, your response to each assignment must demonstrate an understanding of the knowledge of the field. In your response to each assignment, you are expected to demonstrate the depth of your understanding of the subject area by applying your knowledge rather than by merely reciting factual information.

Your responses to the assignments will be evaluated based on the following criteria.

- **Purpose:** the extent to which the response achieves the purpose of the assignment
- **Subject Knowledge:** appropriateness and accuracy in the application of subject knowledge
- **Support:** quality and relevance of supporting evidence
- **Rationale:** soundness of argument and degree of understanding of the subject area

The open-response item assignments are intended to assess subject knowledge. Your responses must be communicated clearly enough to permit valid judgment of the evaluation criteria by scorers. Your responses should be written for an audience of educators in this field. The final version of each response should conform to the conventions of edited American English. Your responses should be your original work, written in your own words, and not copied or paraphrased from some other work.

Be sure to write about the assigned topics. Remember to review your work and make any changes you think will improve your responses.

Any time spent responding to an assignment, including scanning the response sheet(s), is part of your testing time. Monitor your time carefully. When your testing time expires, a pop-up message will appear on-screen indicating the conclusion of your test session. Only response sheets that are scanned before you end your test or before time has expired will be scored. Any response sheet that is not scanned before testing ends will NOT be scored.

101. **Use the information below to complete the assignment that follows.**
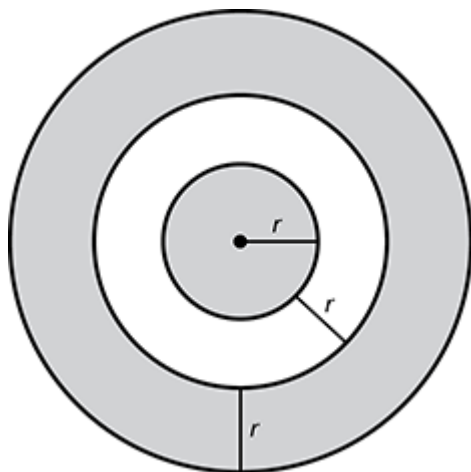
Use your knowledge of geometry and quadratic functions to develop a response of approximately 150–300 words, or 1–2 pages, in which you analyze the area of the shaded regions as a function of the radius of the innermost circle, r. In your response:

- find a formula that describes the area of the shaded regions of the dartboard as a function of the radius of the innermost circle, r;
- graph the equation on a coordinate grid, including all appropriate labels, and explain the meaning of any intercepts and extrema in the context of this situation;
- use the equation to calculate the radius of the innermost circle of a similar dartboard that has the shaded regions with a combined area of 150π square units; and
- describe how the area of the shaded regions would change if the length of the radius of the innermost circle were doubled.

Be sure to show your work and explain the reasoning you use in analyzing and solving this problem.

102. **Use the information below to complete the assignment that follows.**

A city water bureau gets most of the water the city consumes from a reservoir in the mountains that is supplied by rainfall. During the summer, however, there isn't enough rainfall to resupply the reservoir, so water levels in the reservoir fall. When this happens, the bureau has to approve the activation of additional water sources to supplement the water coming in from the reservoir. The bureau estimates that the additional water sources reduce the draw on the reservoir by 4 inches per week.

One summer, the bureau activates the additional water sources on June 15. The water levels in the reservoir for 10 weeks over a period of three months are shown in the following table.

Date	May		June					July		
	18	**25**	**1**	**8**	**15**	**22**	**29**	**6**	**13**	**20**
Week	1	2	3	4	5	6	7	8	9	10
Water Level (in.)	109	104	98	92	84	81	77	74	70	68

Assume that demand for water remains the same throughout the summer, and that regular rainfall starts again at the beginning of October.

Use your knowledge of algebra and statistics to develop a response of approximately 150–300 words, or 1–2 pages, in which you analyze the use of the water sources. In your response:

- draw a graph to show the water levels in the reservoir over time, based on the data in the table;
- predict approximately when the reservoir would have run out of water if the additional sources had not been activated;
- recommend a range of water levels, *w,* for which the reservoir would need to be supplemented with additional water sources, based on *t,* the number of weeks remaining until the beginning of October; and
- discuss factors that could influence the accuracy of your prediction and recommendation.

Be sure to show your work and explain the reasoning you use in analyzing and solving this problem.