Name: _____   **Date:** _____

1. Which statement is true about the asymptotes of $g(x) = \dfrac{2x^2 + 4x + 2}{x^2 - 1}$ and the function f graphed below?
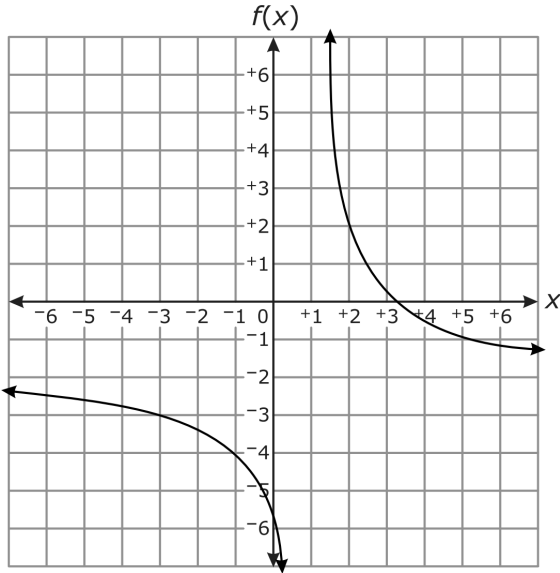
A. The horizontal asymptote of $f(x)$ lies below the horizontal asymptote of $g(x)$.

B. The horizontal asymptote of $f(x)$ lies above the horizontal asymptote of $g(x)$.

C. The number of vertical asymptotes of $f(x)$ is less than the number of vertical asymptotes of $g(x)$.

D. The number of vertical asymptotes of $f(x)$ is greater than the number of vertical asymptotes of $g(x)$.

2. Kathleen rotated an isosceles trapezoid $360°$ around its longest base. Which choice could be the resulting solid?

A.

B.

C.

D.
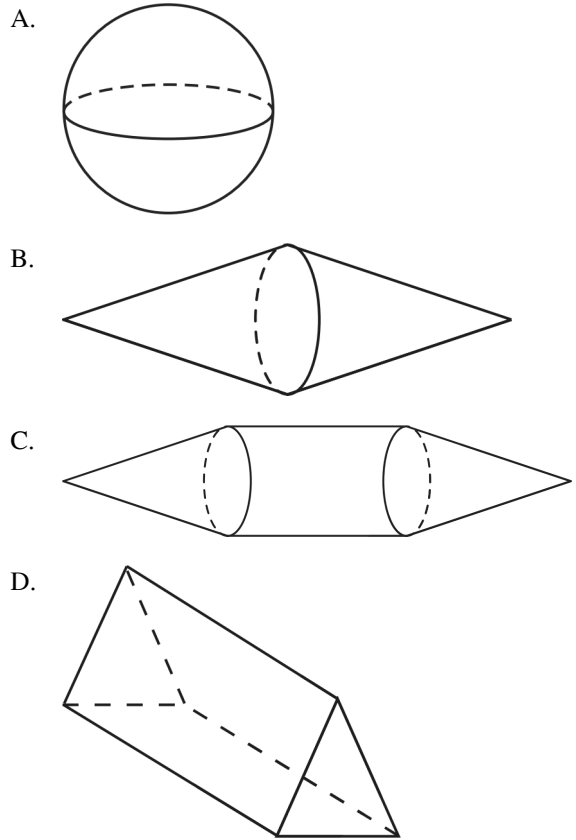
3. Astronomers have observed that sunspots vary sinusoidally. The variation is from a minimum of about 10 sunspots per year to a maximum of about 120 per year. A cycle lasts about 11 years. If a minimum occurred in 1964, which function could model the number of sunspots, S, as a function of the year, t?

A. $S(t) = -55\cos\left(\dfrac{2\pi}{11}(t - 1964)\right) + 65$

B. $S(t) = -55\cos\left(\dfrac{2\pi}{11}t - 1964\right) + 65$

C. $S(t) = -65\cos\left(\dfrac{2\pi}{11}(t - 1964)\right) + 55$

D. $S(t) = -65\cos\left(\dfrac{2\pi}{11}t - 1964\right) + 55$

4. If $\log_2 x = -3$, then x is equal to

    A. 9   B. -6 C. $\frac{1}{8}$ D. -8

5. A right rectangular prism is shown below.
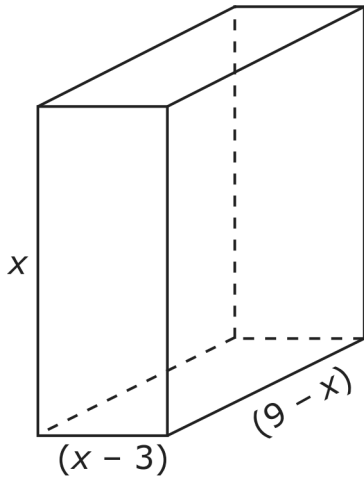
What is the domain for the volume function of the prism?

    A. $0 < x < 9$ B. $0 < x < 3$

    C. $3 < x < 9$ D. $6 < x < 9$

6. To completely cover a spherical ball, a ball company uses a total area of 36 square inches of material. What is the maximum volume the ball can have?

(Note: Surface area of a sphere $= 4\pi r^2$. Volume of a sphere $= \frac{4}{3}\pi r^3$.)

    A. 27π cubic inches   B. $36\sqrt{\pi}$ cubic inches

    C. $\dfrac{36}{\sqrt{\pi}}$ cubic inches   D. $\dfrac{27}{\pi}$ cubic inches

7. The volume of a rectangular prism is represented by the expression $\left(x^3 - 2x^2 - 20x - 24\right)$. If the length is $(x - 6)$ and the height and width are equal, what is the width of the prism?

    A. $x + 2$ B. $x - 2$ C. $x + 4$ D. $x - 4$

8. If $\log_2(x^2 - 1) = \log_2 8$, the the solution set for x is

    A. $\{3, -3\}$ B. $\{-3\}$

    C. $\{3\}$ D. $\{\ \}$

9. A reporter wants to know the percentage of voters in the state who support building a new highway. What is the reporter's population?

    A. the number of people who live in the state

    B. the people who were interviewed in the state

    C. all voters over 25 years old in the state

    D. all eligible voters in the state

10. What is the value of x in the triangle below?
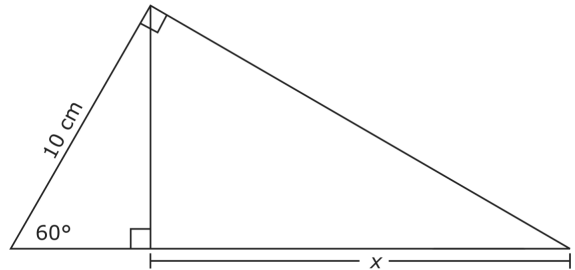
    A. $\dfrac{5\sqrt{3}}{2}$ cm   B. $5\sqrt{3}$ cm

    C. 10 cm   D. 15 cm

11. Which is the inverse of $f(x) = 1.5^x + 4$?

    A. $f^{-1}(x) = \dfrac{x - 4}{1.5}$ B. $f^{-1}(x) = \dfrac{\log(x) - 4}{1.5}$

    C. $f^{-1}(x) = \dfrac{\log(x - 4)}{\log(1.5)}$ D. $f^{-1}(x) = \dfrac{4 - \log(x)}{\log(1.5)}$

12. William put the tip of his pencil on the outer edge of a graph of the unit circle at the point $(0, -1)$. He moved his pencil tip through an angle of $\dfrac{4\pi}{3}$ radians in the counterclockwise direction along the edge of the circle. At what angle of the unit circle did William's pencil tip stop?

    A. $\dfrac{\pi}{3}$ B. $\dfrac{5\pi}{6}$ C. $\dfrac{7\pi}{6}$ D. $\dfrac{5\pi}{3}$

13. Which expression is equivalent to $\dfrac{\sin^4(\theta) - \cos^4(\theta)}{\sin^2(\theta) - \cos^2(\theta)}$, where $\sin^2(\theta) \neq \cos^2(\theta)$

    A. $\sin^2(\theta) - \cos^2(\theta)$ B. $\cos^2(\theta) - \sin^2(\theta)$

    C. 2   D. 1

14. Samantha invested $10,000 in each of two different financial plans in 2013. The predicted value of each plan is modeled below.

- Plan M: a rate of 7.5%, compounded continuously.
- Plan N: The value is determined by the function $y = 5x^3 - 50x^2 + 4x + 10,000$, where x is the number of years after 2013.
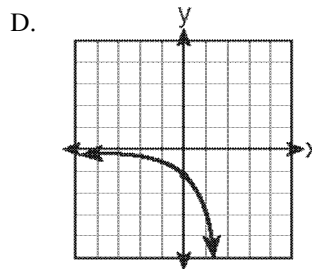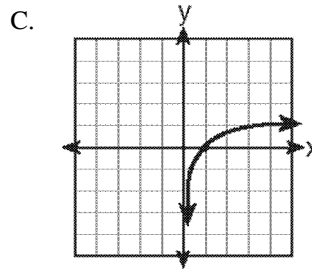
Plan N has a greater predicted value than Plan M during which years?

    A. from 2014 to 2041

    B. from 2028 to 2055

    C. from 2042 to 2073

    D. Plan N never has a greater value than Plan M.
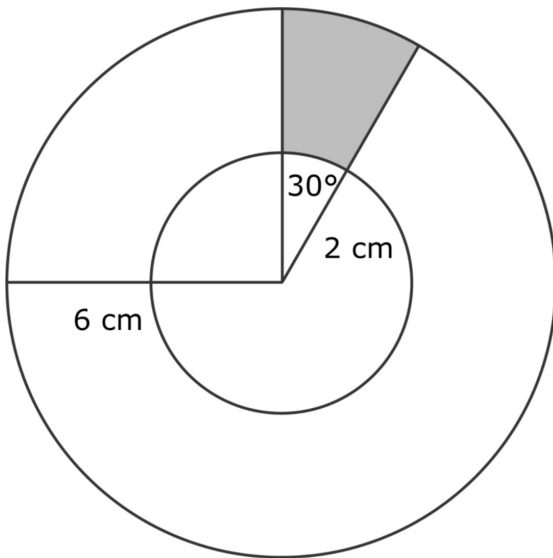
15. What is the *approximate* solution to the equation $3^{x-1} = 4^{2x+5}$?

    A. 3.875   B. 1.262

    C. −2.354   D. −4.797

16. Which graph represents the inverse of the equation $y = 3^x$?

A.

B.

C.

D.
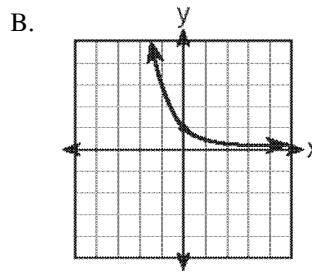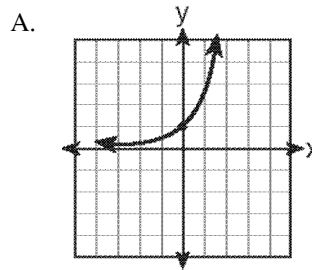
17. In the figure below, the larger circle has a radius of 6 cm, and the smaller circle has a radius of 2 cm.

What is the *approximate* area of the shaded region?

A. $2.1\,\text{cm}^2$ B. $3.4\,\text{cm}^2$

C. $4.2\,\text{cm}^2$ D. $8.4\,\text{cm}^2$

18. The diameter of a circle is 8 centimeters. A central angle of the circle intercepts an arc of 12 centimeters. What is the radian measure of the angle?

A. $\frac{3}{2}$ B. 3 C. 4 D. 8π

19. A farmer wants to buy between 90 and 100 acres of land.

- He is interested in a rectangular piece of land that is 1,500 yards long and 300 yards wide.
- The piece of land is being sold as one complete unit for $87,000.

If the farmer does not want to spend more than $900 an acre, does the land meet all of his requirements? (1 acre $\approx 43,560\text{ft}^2$)

A. Yes, the amount of land satisfies his needs, and the price is low enough.

B. No, the price is low enough, but there is too much land.

C. No, the price is low enough, but there is not enough land.

D. No, the amount of land satisfies what he needs, but the price is too high.

20. The surface area of a balloon can be represented by the function $S(r) = 4\pi r^2$, where r is the radius of the balloon. If r increases with time, t, and is represented by the function $r(t) = \frac{1}{4}t^2$, what is the surface area of the balloon expressed as a function of time?

A. $S(t) = 4\pi t^2$ B. $S(t) = \pi t^2$

C. $S(t) = \dfrac{\pi t^4}{4}$ D. $S(t) = \dfrac{\pi^2 t^2}{16}$

21. Which expression is equivalent to $\dfrac{\cos(\theta)}{1 - \sin(\theta)} - \tan(\theta)$?

A. $\sec(\theta)$ B. $\sin(\theta)$

C. $\cos(\theta)$ D. $\csc(\theta)$

22. Suppose $p(x) = x^3 - 2x^2 + 13x + k$. The remainder of the division of $p(x)$ by $(x + 1)$ is -8. What is the remainder of the division of $p(x)$ by $(x - 1)$?

A. -8 B. 8 C. 16 D. 20

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23. The expression $\log_5 \frac{1}{25}$ is equivalent to

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

24. The value of an account that is being compounded continuously is given by the formula $A = Pe^{rt}$, where P is the principal, r is the annual interest rate, and t is the time in years. *Approximately* how long will it take for the amount of money to double if the interest rate is 2.4%?

   A.   11.0 years   B.   12.9 years

   C.   20.0 years   D.   28.9 years

25. What is the value of x if $\dfrac{h+5}{x} - 3 = 12$?

   A. $x = \dfrac{h}{10}$ B. $x = \dfrac{h}{3}$

   C. $x = \dfrac{h}{3} + \dfrac{1}{3}$ D. $x = \dfrac{h}{15} + \dfrac{1}{3}$

26. A function is shown below.

$$f(x) = \begin{cases} -x^2 + 2x & \text{for } x \le -3 \\ 2\left(\dfrac{1}{3}\right)^{2x} & \text{for } -3 < x < 4 \\ \dfrac{2x-5}{x-7} & \text{for } x \ge 4 \end{cases}$$

   What is the value of the expression $f(-3) + 2f(-1) - f(4)$?

   A. $\dfrac{101}{36}$ B. $\dfrac{32}{9}$ C.   4   D.   22

27. If $\log_x 9 = -2$, what is the value of x ?

   A.   81   B. $\frac{1}{81}$ C.   3   D. $\frac{1}{3}$

28. A student wants to determine the most liked professor at her college.

   Which type of study would be the *most* practical to obtain this information?

   A.   a simulation   B.   an experiment

   C.   a survey   D.   an observation

29. The expression $\frac{1}{2}\log a - 2\log b$ is equivalent to
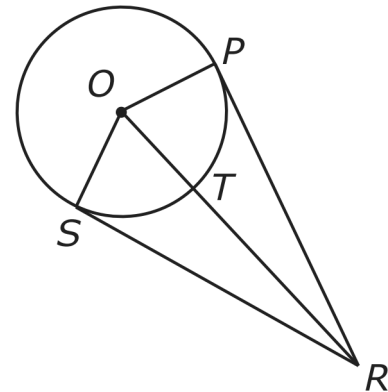
   A. $\log \dfrac{\sqrt{a}}{b^2}$ B. $\log \sqrt{ab}$

   C. $\log \dfrac{a^2}{\sqrt{b}}$ D. $\log(\sqrt{a} - b^2)$

30. What is the inverse of the function $y = \log_4 x$?

   A. $x^4 = y$ B. $y^4 = x$ C. $4^x = y$ D. $4^y = x$

31. Solve for x: $\log_3(x^2 - 4) - \log_3(x+2) = 2$

32. In the figure below, $\overline{PR}$ and $\overline{SR}$ are tangent to circle O.

   If $OT = 11$ cm and $PR = 60$ cm, what is the length of $\overline{OR}$?

   A.   61 cm   B.   59 cm   C.   50 cm   D.   48 cm

33. A box with an open top will be constructed from a rectangular piece of cardboard.

   - The piece of cardboard is 8 inches wide and 12 inches long.
   - The box will be constructed by cutting out equal squares of side x at each corner and then folding up the sides.

   What is the entire domain for the function $V(x)$ that gives the volume of the box as a function of x?

   A. $0 < x < 4$ B. $0 < x < 6$

   C. $0 < x < 8$ D. $0 < x < 12$

34. Given the function:

$$g(x) = \frac{(x-2)(3x+2)}{(x+4)(x-2)(x-6)}$$

   a) What are the equations of the asymptotes of the function?

   b) Determine if there are any points of discontinuity. Explain why or why not.

   c) Describe the end behavior as x approaches $-\infty$, and as x approaches $+\infty$.

35. Let $f(x) = 14x^3 + 28x^2 - 46x$ and $g(x) = 2x + 7$. Which is the solution set to the equation $\frac{1}{12}f(x) = g(x)$?

   A. $\{-3, 0, 1\}$ B. $\{-3, -1, 2\}$

   C. $\{-2, 1, 3\}$ D. $\{1, 5, 11\}$

36. The expression $\log \dfrac{\sqrt{x^2 y^3}}{z}$ is equivalent to

   A. $\dfrac{1}{2}(2\log x + 3\log y - \log z)$

   B. $\dfrac{1}{2}(2\log x + 3\log y) - \log z$

   C. $2\log x + 3\log y - \log z$

   D. $\dfrac{x^2 y^3}{z}$

37. The expression $2\log x - (3\log y + \log z)$ is equivalent to

   A. $\log \dfrac{x^2}{y^3 z}$ B. $\log \dfrac{x^2 z}{y^3}$

   C. $\log \dfrac{2x}{3yz}$ D. $\log \dfrac{2xz}{3y}$

38. Which expression is equivalent to $(4 - 3i)^2 + (6 + i)^2$?

   A. 30 B. $42 - 12i$

   C. 50 D. $62 - 12i$

39. What is the inverse relation of the function whose equation is $y = 3x - 2$?

   A. $y = x$ B. $y = 3x + 2$

   C. $y = 2x - 3$ D. $y = \dfrac{x+2}{3}$

40. What is the solution to the equation below?

$$\frac{\frac{3}{x} + 2}{\frac{x}{5} + 1} = \frac{15}{x}$$

   A. -12 B. -2 C. 2 D. 12

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1.
Answer: A

2.
Answer: C

3.
Answer: A

4.
Answer: C

5.
Answer: C

6.
Answer: C

7.
Answer: A

8.
Answer: A

9.
Answer: D

10.
Answer: D

11.
Answer: C

12.
Answer: B

13.
Answer: D

14.
Answer: C

15.
Answer: D

16.
Answer: C

17.
Answer: D

18.
Answer: B

19.
Answer: D

20.
Answer: C

21.
Answer: A

22.
Answer: D

23.
Answer: D

24.
Answer: D

25.
Answer: D

26.
Answer: D

27.
Answer: D

28.
Answer: C

29.
Answer: A

30.
Answer: C

31.
Answer: 11

32.
Answer: A

33.
Answer: A

34.
Answer: $x = -4$, $x = 6$, and $y = 0$; [explanation]; [description]

35.
Answer: B

36.
Answer: B

37.
Answer: A

38.
Answer: B

39.
Answer: D

40.
Answer: A