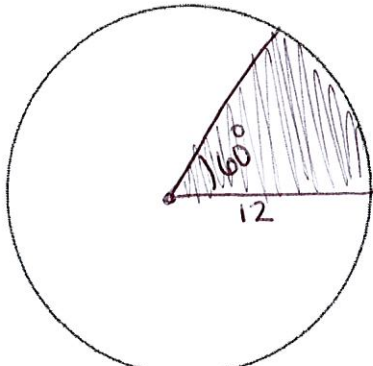


MATH 3 NATIONAL BENCHMARK ITEMS

1 The circle has a radius of 12 units. Shade an area of 24π square units.



$$24\pi = \pi r^2 \left(\frac{\theta}{360}\right)$$

$$24 = (12)^2 \left(\frac{\theta}{360}\right)$$

$$24 = 144 \left(\frac{\theta}{360}\right)$$

$$\frac{1}{6} = \frac{\theta}{360} \quad \theta = 60^\circ$$

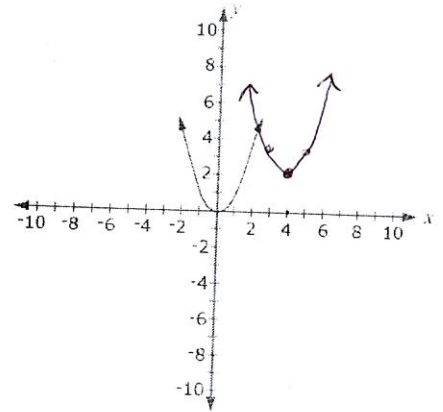
2 For what value of m is the equation true?

$$x^2 + 10x + 11 = m + (x + 5)^2 - 25$$

$$\cancel{x^2} + \cancel{10x} + 11 = m + \cancel{x^2} + \cancel{10x} + \cancel{25} - 25$$

$$11 = m$$

3 The graph of $y = x^2$ is shown on the grid. Make a new graph to show $y = (x - 4)^2 + 2$.



4 Mr. and Mrs. Ryan build and sell nesting boxes for small birds. They sell each box for \$19.95. So far this month, they have built and sold 74 boxes.

Part A Let x represent the number of additional boxes they expect to build and sell for the month. Let $n(x)$ represent the amount of money they expect to receive from the entire month's sales. Write an equation for $n(x)$.

$$n(x) = 19.95x + 1476.30$$

Part B Determine the average rate of change, in dollars per nesting box, of $n(x)$ as x varies from 85 to 120.

$$\frac{3870.3 - 3172.05}{120 - 85} = 19.95$$

Part C Mr. and Mrs. Ryan can build no more than 450 boxes in one month. Which statement gives the domain of function n ?

- A. $0 \leq x < 450$, where x is a whole number
- B. $0 \leq x \leq 450$, where x is a whole number
- C. $0 < x < 376$, where x is a whole number
- D. $0 \leq x \leq 376$, where x is a whole number**

Part D The materials for each nesting box cost a total of \$11.75. Write a function $P(s)$ for the profit the Ryans earn when they sell s nesting boxes.

$$P(s) = (19.95 - 11.75)s$$

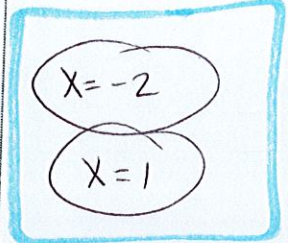
$$\text{OR } P(s) = 8.20s$$

5 Let $f(x) = -x + 3$ and $g(x) = 3|x| - 1$. Where do the graphs of $f(x)$ and $g(x)$ intersect?

$$-x + 3 = 3|x| - 1$$

$$-x + 4 = 3|x|$$

$$-\frac{x}{3} + \frac{4}{3} = |x|$$



$$x = -\frac{1}{3}x + \frac{4}{3}$$

$$\frac{4}{3}x = \frac{4}{3} \quad x = 1$$

$$x = \frac{1}{3}x - \frac{4}{3}$$

$$\frac{2}{3}x = -\frac{4}{3} \quad x = -2$$

6 Joanna uses the function $p = f(n) = 30n - 450$ to calculate the profit, p , in dollars that she makes from selling n cakes in her store.

- Write a formula for a function to calculate the number of cakes Joanna needs to sell for a given profit.
- Calculate the minimum number of cakes that Joanna must sell to make a profit of at least \$500.00.

Formula: $n = f^{-1}(p) = \frac{p + 450}{30}$

Minimum number of cakes: $\frac{500 + 450}{30} = \frac{950}{30} = 31.67$

$$y = 30x - 450$$

$$x = 30y - 450$$

$$x + 450 = 30y$$

7

The equation $x^2 - 10x + 17 = -y^2 - 2y$ describes a circle in the coordinate plane.

Find the radius of the circle and the coordinates of its center.

$$x^2 + 10x + y^2 + 2y = -17 + 25 + 1$$

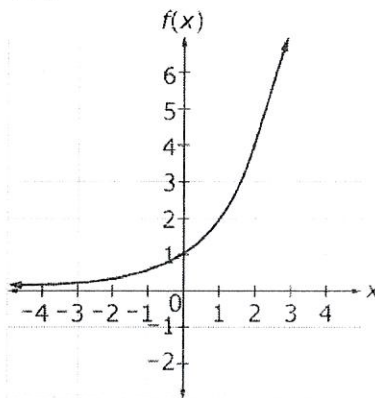
$$(x+5)^2 + (y+1)^2 = 9$$

center: $(-5, -1)$

radius = 3

8

The graph of an exponential function f passes through $(0, 1)$ and $(2, 4)$, as shown.



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

$$y = 2^x$$

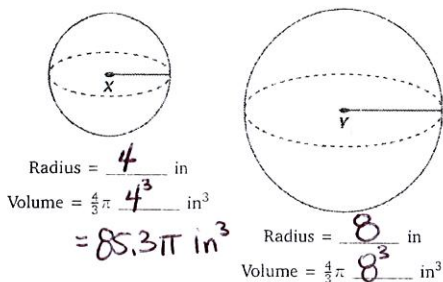
$$f(6) = 2^6 = 64$$

9

The radius of sphere Y is twice the radius of sphere X. A student claims that the volume of sphere Y must be exactly twice the volume of sphere X.

Part A

Evaluate the student's claim.



Part B

Decide whether the student's claim is true, false or cannot be determined. Select the correct option.

The larger circle is 8 times bigger in volume,
OR 2^3 bigger.

10

Suppose that θ is a second quadrant angle and that $\cos \theta = -\frac{4}{5}$. What is the value of $\sin \theta$ to the nearest tenth?



$$\sin \theta = \frac{3}{5} = .6$$

Part A

Let x and y represent natural numbers. Prove that the following equation is true for all x and y values. Show your work or explain your answer.

$$(x^2 + y^2)^2 - (x^2 - y^2)^2 = (2xy)^2$$

Part B

Jenna claims that $x^2 - y^2$, $2xy$, and $x^2 + y^2$ can be used to find side lengths for right triangles. Explain why Jenna is correct. Also, explain what restrictions, if any, must be placed on the values of x and y when they are being used to find side lengths for right triangles.

answer on separate sheet

12

Which equations are true for all values of x ?

Select *all* that apply.

$3^{2-x} = 3^2 - 3^x$

$3^{x+2} = 9(3^x) = (3^2)(3^x) = 3^{2+x}$

$(3^x)^2 = (3^2)^x$

$9^{x+2} = 3^{2x+4} \rightarrow (3^2)^{x+2} = 3^{2x+4}$

$27^x = (3^x)^3$

$(3^3)^x$

Part A

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

$$\cancel{x^4} + 2x^2y^2 + \cancel{y^4} - \cancel{x^4} + 2x^2y^2 - \cancel{y^4} = 4x^2y^2$$
$$4x^2y^2 = 4x^2y^2$$

Part B

Jenna can use this for pythagorean theorem because $(x^2 + y^2)^2 - (x^2 - y^2)^2 = (2xy)^2$ is in the same form as $c^2 - a^2 = b^2$, which is pythagorean thm rearranged.

$$x^2 + y^2 \geq 0$$

$$2xy \geq 0$$

$$x^2 - y^2 \geq 0$$

$$2xy + x^2 - y^2 \geq x^2 + y^2$$

$$(kg) \left(\frac{m}{s}\right)^2 = \frac{kg m^2}{s^2}$$

13

Given the formula $K = \frac{1}{2}mv^2$, where

- K represents kinetic energy
- m represents mass has units of kilograms (kg), and
- v represents velocity and has units of meters per second (m/s).

Select an appropriate measurement units for kinetic energy.

A. $\frac{kgm}{s^2}$

B. $\frac{kgm^2}{s}$

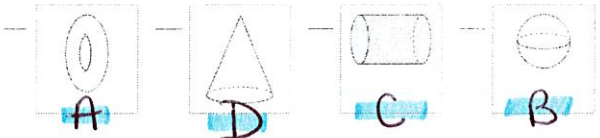
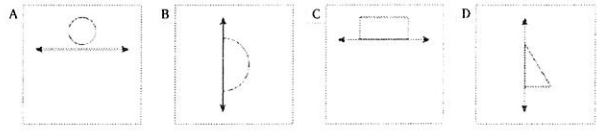
C. $\frac{kgm^2}{s^2}$

D. $\frac{kg^2m^2}{s^2}$

14

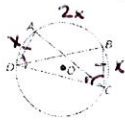
Each of the two-dimensional figures shown will be rotated 360° about the respective line, creating a three-dimensional figure.

Match the two-dimensional figures with the three-dimensional figures to identify the correct representation of the resulting three-dimensional figure.



15

In circle O , points $A, B, C,$ and D lie on the circle; \widehat{AD} is congruent to \widehat{BC} ; and the measure of \widehat{AB} is twice the measure of \widehat{BC} .



Part A

Select from the choices to correctly complete the statement. The measure of $\angle ACD$ is _____ the measure of $\angle ADC$.

- A. a third
- B. half
- C. equal to
- D. twice
- E. three times**

Part B

Select from the choices to correctly complete the statement. The measure of $\angle ADC$ is _____ the measure of $\angle BCD$.

- A. a third
- B. half
- C. equal to**
- D. twice
- E. three times

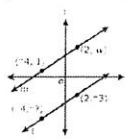
$$\angle ADC = \frac{3x}{2} = \frac{3}{2}x$$

$$\angle ACD = \frac{x}{2} = \frac{1}{2}x$$

16

Part A

Line l passes through the points $(-4, -7)$ and $(2, -3)$ on the coordinate plane. Line m passes through the points $(-4, 1)$ and $(2, w)$.



$$\frac{-7 - (-3)}{-4 - 2} = \frac{-4}{-6} = \frac{2}{3}$$

$$\frac{1 - w}{-4 - 2} = \frac{1 - w}{-6}$$

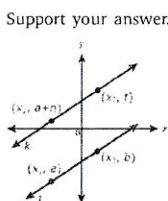
$$1 - w = -4$$

$$\frac{-w = -5}{w = 5}$$

For what value of w is line m parallel to line l ?

Part B

Given the figure, write an expression that can replace t and will guarantee that lines j and k are parallel.



$$\frac{b-a}{x_2-x_1} = \frac{t-a-n}{x_2-x_1}$$

$$b-a = t-a-n$$

$$b = t-n$$

$$(b+n) = t$$

17

There is a unique quadratic function of the form $f(x) = ax^2 + c$ that satisfies each of these conditions:

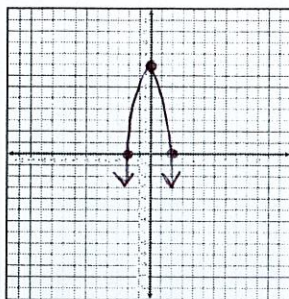
- $f(-2) = f(2) = 0$
- f attains a maximum value of 8

$$\rightarrow (-2, 0) \text{ \& } (2, 0)$$

$$\rightarrow (0, 8)$$

Part A

Create a graph of $f(x)$.



Part B

Circle the correct choices from the lists to correctly complete the sentence.

The function f is symmetric about the y-axis because for all values of x , $f(-x) = -f(x)$.

18

Choose two numbers whose product is irrational.

| | | | | | |
|---------|-----------|---------------|---------------|-------------------------------|------------|
| Numbers | -5 | $\frac{1}{3}$ | $\frac{2}{3}$ | $3\sqrt{2}$ | $\sqrt{8}$ |
|---------|-----------|---------------|---------------|-------------------------------|------------|

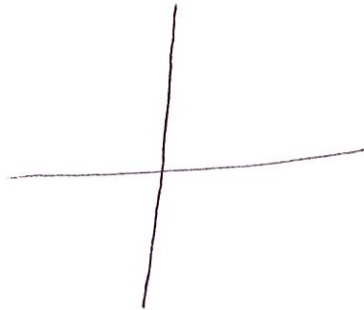
$$3\sqrt{2} \cdot -5 = -15\sqrt{2}$$

← irrational

19

Suppose $\angle A$ is an angle such that $\cos A < \sin A$. Select *all* angle measures that are possible values for $\angle A$.

- 25°
 35°
 45°
 55°
 65°
 75°



21

Data were collected on the number of kilowatt-hours (kWh) of electricity customers used each month. The data were fit into a function. The function $f(x) = 650 \sin(0.6x - 2.8) + 962$ gives the number of kWh of electricity used during month x . Month 1 corresponds to January.

The electric company charges \$0.0715 per kWh up to 500 kWh. Then the company charges \$0.1042 per kWh for kWh used above 500. The company also charges \$8.00 in fees. How many kWh would a customer use in April, and what would the total cost be?

$$650 \sin(0.6(4) - 2.8) + 962 = 108.878$$

$$0.0715(500) + 0.1042(208.878) + 8$$

$$\boxed{\$65.52}$$

23

A quiz in math class consisted of 5 true or false questions. Only 4 out of 30 students in Mr. Denario's class got all 5 questions correct. Mr. Denario used a simulation of flipping a coin to represent the result of his class quiz. He used heads to represent a correct answer and tails to represent an incorrect answer. He flipped 5 coins to represent the 5 problems on the quiz and recorded the number of heads group of 5 coins. He repeated the simulation 100 times and recorded the results in this table.

| Total Number of Heads | Number of Samples (out of 100 samples) |
|-----------------------|--|
| 0 | 2 |
| 1 | 25 |
| 2 | 22 |
| 3 | 34 |
| 4 | 13 |
| 5 | 4 |

Which conclusion is supported by the data for the class and the simulation?

- A. The simulation model is consistent with the class data because in both the observed class results and the simulation model the result of all heads on all 5 problems correct was 4.
 B. The simulation model is consistent with the class data because each coin flipped and each question on the test had only two outcomes and an equal chance of getting either outcome.
 C. The simulation model is not consistent with the class data because there are 30 students in the class and there were 100 samples in the coin simulation.
 D. The simulation model is not consistent with the class data because the observed class results had 13% of the students with all 5 problems correct, and the simulation model only had 4% of the samples with all 5 heads.

20

$$j^4 - 16 + j^4 - 8j^2 + 16$$

Part A

Write the expression $j^4 - 16 + (j^2 - 4)^2$ without parenthesis and with all like terms combined.

Part B

$$2j^4 - 8j^2$$

Which expressions are equivalent to the expression $j^4 - 16 + (j^2 - 4)^2$?

Select *all* that apply.

$(j^2 - 4)(j^2 + 4) = j^4 - 16$

$2j^2(j + 2)(j - 2) = 2j^2(j^2 - 4) = 2j^4 - 8j^2$

$(j - 2)(j + 2)(j^2 + 4) = (j^2 - 4)(j^2 + 4) = j^4 - 16$

$(j^2 + 4)(j^2 - 4)(j^2 - 4) = (j^2 - 16)(j^2)$

$(j^2 - 4)(j^2 + 4 + j^2 - 4)(j^2 - 4)(j^4)$

$(j^2 + 4)(j^2 - 4) + (j^2 - 4)^2$
 $(j^4 - 16) + (j^4 - 8j^2 + 16) = 2j^4 - 8j^2$

22

What value of x satisfies the equation $\log_3(x - 4) = 2$?

- A. 5 B. 10 C. 12 **D. 13**

$$3^2 = x - 4$$

$$3^2 + 4 = x$$

$$9 + 4 = x$$

$$\boxed{x = 13}$$

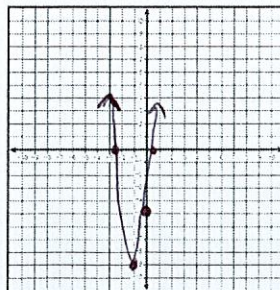
24

To prepare for a test, three students have been asked to present a review lesson to their class on sketching the graph of a parabola in the xy -coordinate plane. They decide to use the quadratic function $f(x) = 4x^2 + 10x - 5$ in their presentation. Each student will use algebra to explain how to find one of three key features of the graph.

- Angela rewrites the equation in factored form.
- Benjamin rewrites the equation by completing the square.
- Carla evaluates $f(0)$.

Part A

Sketch the graph of the function on the xy -coordinate grid shown.



Part B

Describe how each student's work contributes to the finding of key features of the graph. Complete their work and describe the key feature that is revealed.

Angela helped locate the roots
 Benjamin found the vertex
 Carla found the y-int.

Angela $\frac{-10 \pm \sqrt{100 - 4(4)(-5)}}{2(4)}$

$$4x^2 + 10x - 5$$

$$2x(2x + 5) - 1(2x + 5)$$

$$f(x) = (2x - 1)(2x + 5)$$

$$4(x^2 + 2x + 1) - 5 - 4$$

$$4(x + 1)^2 - 9$$

25

Determine whether each expression is equivalent to $(x^3 + 8)$. Select Yes or No for each expression.

| | Yes | No |
|-------------------------|-------------------------------------|-------------------------------------|
| $(x + 8)^3$ | | <input checked="" type="checkbox"/> |
| $(x - 2)(x^2 + 2x + 4)$ | | <input checked="" type="checkbox"/> |
| $(x + 2)(x^2 - 2x + 4)$ | <input checked="" type="checkbox"/> | |

26

A unicyclist rides his unicycle across a stage. The wheel has a diameter of 2 feet, and the distance he rides across the stage is 40 feet. What is the angle, in radians, that the wheel turned in rolling that distance?

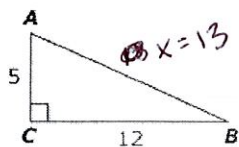
~~circumference~~ $d = 2, r = 1$
 $2\pi \rightarrow$ Circumference of wheel
 6.28 ft

$$\frac{40}{6.28} = 6.36 \text{ rotation} \times 2\pi =$$

$$12.73\pi$$

27

Consider this right triangle.



$$x = 13$$

Determine if each expression is equivalent to the length of AC. Select Yes or No for each expression.

| | Yes | No |
|-------------|-------------------------------------|-------------------------------------|
| $13 \sin B$ | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| $13 \cos A$ | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| $12 \tan A$ | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| $12 \tan B$ | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

$$\sin B = \frac{5}{x}$$

$$x \sin B = 5$$

$$\cos A = \frac{5}{x}$$

$$x \cos A = 5$$

$$\tan A = \frac{12}{5}$$

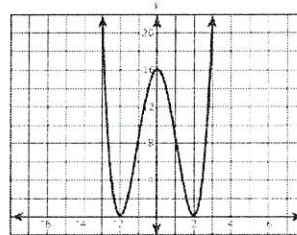
$$5 \tan A = 12$$

$$\tan B = \frac{5}{12}$$

28

Part A

The graph $y = P(x)$ is shown.



What property of an even function do you see in this graph?

Symmetric across the y-axis

Part B

An equation for $y = P(x)$ is shown.

$$y = P(x) = x^4 - 8x^2 + 16$$

State the algebraic definition of an even function. Show algebraically that $P(x)$ is an even function for all values of x .

$$f(x) = f(-x) \quad f(-x) = (-x)^4 - 8(-x)^2 + 16 \quad \checkmark$$

29

Solve the following equation for n .

$$18n^2 - 50 = 0$$

Write one solution in the space below. If there are two solutions, write the second solution in the space below.

$$2(9n^2 - 25) = 0$$

$$2(3n - 5)(3n + 5) = 0$$

$$3n - 5 = 0 \quad 3n + 5 = 0$$

$$3n = 5 \quad 3n = -5$$

$$n = \frac{5}{3}$$

$$n = -\frac{5}{3}$$

30

$$(-1)^4 x^4 - 8(-1)^2 (x)^2 + 16$$

$$x^4 - 8x^2 + 16 \quad \checkmark = f(x)$$

Functions f and g are defined as $f(x) = 2^x$ and $g(x) = x + 3$.

What are the values of x to the nearest hundredth when $f(x) = g(x)$?

$$x_1 = -2.86$$

$$2^x = x + 3$$

$$x_2 = 2.44$$

31

The management of a furniture store chain wanted to determine which color of couch adults in the United States preferred. The management conducted a survey of a random sample of adults in the United States. The number of people who preferred each color is shown in the table.

| Color of Couch Preferred | |
|--------------------------|------------------|
| Color | Number of People |
| black | 143 |
| blue | 108 |
| brown | 210 |
| green | 93 |
| red | 126 |
| white | 204 |

Part A

What is the population of the study?

A. the color of couch preferred

B. all adults in the United States

C. 884 adults selected at random

D. the adults surveyed who preferred blue

← parameter of interest
← sample
← proportion

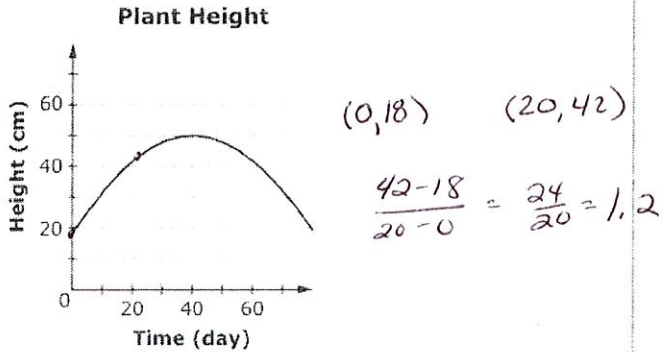
Part B

What is the estimated proportion of the population that prefers brown couches? Round your answer to the of a percent.

$$\frac{210}{884} = .2375 \approx 23.75\%$$

32

The height of a plant, in centimeters, is modeled as a function of time, in days. Consider this graph of the function.

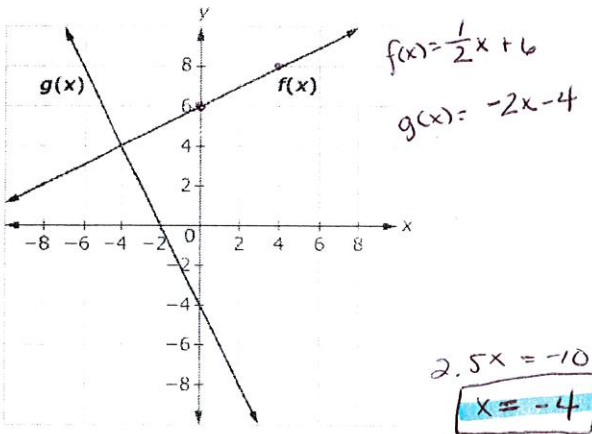


Write the average rate of change for the height of the plant, measured in centimeters per day, between day 0 and day 20.

1.2 cm per day

33

This graph shows linear equations $y = f(x)$ and $y = g(x)$.



Write the solution to the equation $f(x) - g(x) = 0$.

$$\frac{1}{2}x + 6 + 2x + 4 = 0 \quad 2.5x + 10 = 0$$

34

Jim can paint a house in 12 hours. Alex can paint the same house in 8 hours.

Write an equation that can be used to find the time in hours, t , it would take Jim and Alex to paint the house together.

$$8 \cdot \frac{x}{12} + \frac{x}{8} = 1 \cdot \frac{96}{96}$$

$$8x + 12x = 96$$

$$20x = 96$$

x = 4.8 hours

35

The function f is defined as $f(x) = x(x^2 - 4) - 3x(x - 2)$.

Part A

An equivalent form of f is given as $f(x) = x(x - 2)(x - a)$, where a is a constant. What is the value of a ?

Part B

Which values are the zeros of the function f ?

Select all that apply.

- 3
- 2
- 1
- 0
- 1
- 2
- 3

$$x^3 - 4x - 3x^2 + 6x$$

$$x^3 - 3x^2 + 2x$$

$$x(x^2 - 3x + 2)$$

$$x(x - 2)(x - 1)$$

$$x^3 - 3x^2 + 2x$$

$$x(x^2 - 3x + 2)$$

$$x(x - 2)(x - 1)$$

a = 1

36

A landscaper is designing a display of flowers for an area in a public park. The flower seeds will be planted at points that lie on a circle that has a diameter of 8 feet. The point where any seed is planted must be at least 2 feet away from the seeds on either side of it.

Part A

What is the maximum number of flower seeds that can be planted using the design?

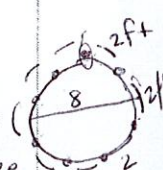
$$12.565$$

Part B

After planting the flower seeds, the landscaper has 20 seeds left over. The landscaper wants to plant all of the remaining seeds in another circle so that the seeds are 2 feet apart. To the nearest tenth of a foot, what is the diameter of the smallest circle that the landscaper can use to plant all of the remaining seeds?

$$40 = 2\pi \cdot r$$

d = 12.73 ft



The organizers of a community fair set up a small Ferris wheel for the young children. The table shows the heights of one of the cars above the ground for different rotations of the wheel.

| Angle of Rotation (radians) | Height above the Ground (feet) |
|-----------------------------|--------------------------------|
| 0 | 1 |
| $\pi/2$ | 7 |
| π | 13 |
| $3\pi/2$ | 7 |
| 2π | 1 |
| $5\pi/2$ | 7 |
| 3π | 13 |
| $7\pi/2$ | 7 |
| 4π | 1 |

highest: 13
lowest: 1

Part A

The function $f(x) = a \sin(x - \frac{x}{2}) + b$, where a and b are constants, models the height of the Ferris wheel car at a rotation of x radians.

What are the values of a and b ?

- $a = 1; b = 12$
- $a = 6; b = 7$
- $a = 7; b = 6$
- $a = 12; b = 1$

Part B

Consider the graph of $y = f(x)$ in the xy -coordinate plane. Which statements are true?

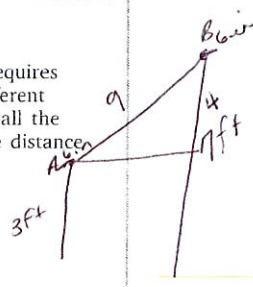
Select *all* that apply.

- The amplitude of the graph is 12.
- The period of the graph is 2π .
- The midline of the graph is at $y = 13$.
- The graph is increasing for $4\pi < x < 5\pi$.
- The graph is decreasing for $\frac{11\pi}{2} < x < \frac{13\pi}{2}$.
- The graph has a maximum at $y = 13$.

5π decreasing
 6π

38

Samantha invented a new outdoor game. The game requires attaching a rope between the tops of two poles of different heights. Read the instructions Samantha created. Use all the given information to determine the maximum allowable distance between the base of pole A and the base of pole B.



Game Instructions

Materials needed: Pole A, Pole B, 10 feet of rope

Setup:

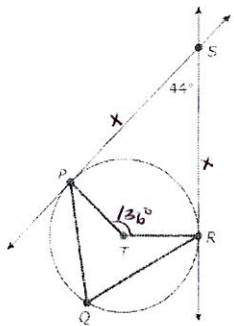
- Place pole A perpendicular to the ground so that its height is 3 feet.
- Place pole B perpendicular to the ground so that its height is 7 feet.
- The length of the rope must extend at least 6 inches past the top of each pole for proper assembly.
- Attach the rope to the top of the two poles.

Write the *maximum* distance between the base of pole A and the base of pole B to the nearest whole foot.

8 ft

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Circle T is shown. Line PS and line RS are tangent to circle T .



Part A

What is the measure, in degrees, of $\angle PTR$? 136°

Part B

What is the measure, in degrees, of $\angle PQR$? 68°

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Consider the equation $p^2 - 5p - 6 - x(p-6)^2 = 0$, where p is a real constant.

Part A

If $p = 6$, then the equation has

- A. no real solutions.
- B. exactly one real solution.
- C. exactly two real solutions.
- D. infinitely many real solutions.

$p^2 - 5(6) - 6 - x(6-6)^2 = 0$
 $36 - 30 - 6 - x(0)^2 = 0$
 $0 - 0 = 0$
 $0 = 0$

Part B

If $p \neq 6$, then $x =$

- A. $\frac{p-2}{p-6}$
- B. $\frac{p-1}{p-6}$
- C. $\frac{p+1}{p-6}$
- D. $\frac{p+2}{p-6}$

$p^2 - 5p - 6 - x(p-6)^2 = 0$
 $p^2 - 5p - 6 = x(p-6)^2$
 $(p-6)(p+1) = x(p-6)(p-6)$
 $(p-6)(p+1)$

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A solution for each equation is given.

Write the letter of each equation in the appropriate box for its solution.

A $-4x + 20 - a = 4(x+5) + a$
 $-a = a$

B $4x - 20 + 2a = 4(x-5) + a + 1$
 $2a = a + 1$
 $a = 1$

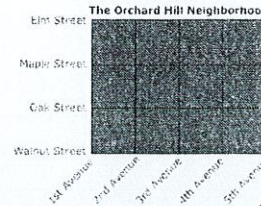
$a = 1$ $a = 0$ $a = -1$

B A

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The number of people who live in a unit of area is called the *population density* of the area. It is usually given as people "per square mile" or "per square kilometer."

A map of the Orchard Hill Neighborhood is shown. The population of the Orchard Hill Neighborhood is 360 people. The length of each block is the same and the length of 20 blocks is 1 mile.



$x = \frac{p+1}{p-6}$
 $\left. \begin{matrix} 0.05 \\ 0.15 \end{matrix} \right\}$

Part A

What is the area in square miles of Orchard Hill?

- A. 0.03 square mile
- B. 0.15 square mile
- C. 0.35 square mile
- D. 0.60 square mile

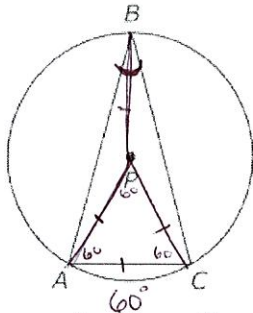
Part B

What is the population density of the Orchard Hill Neighborhood, given as a number of people per square mile?

$\frac{360}{0.03} = \frac{x}{1}$ 12000 people per sq. mile

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The figure shows a circle with center P and inscribed isosceles $\triangle ABC$.



If \overline{AC} has the same length as the radius of the circle, what is the measure of $\angle ABC$?

$\angle ABC = 30^\circ$

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Part A

A circle in the xy -coordinate plane has the equation $x^2 + y^2 + 6y - 4 = 0$. If the equation of the circle is written in the form $x^2 + (y + k)^2 = c$, where k and c are constants, what is the value of k ?

Part B

What is the radius of the circle?

A. 2

B. 4

C. $\sqrt{13}$

D. 13

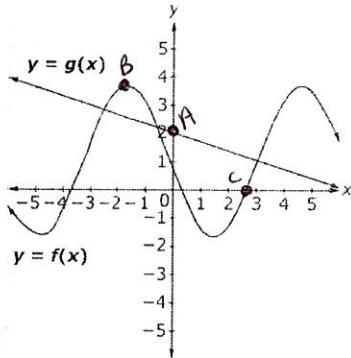
$x^2 + (y+3)^2 = 4+9$
13

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The graphs of $y = g(x)$ and $y = f(x)$ are shown.

Add a point that will satisfy each given condition.

- A • A point on the graph of g where $x = 0$ $(0, 2)$
- B • A point on the graph of g where $f(x) > g(x)$ $(-2, 4)$
- C • A point on the graph of f where $f(x) = 0$ $(2, 8, 0)$



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Let $f(x) = 2x^2 - x + 1$ and let $g(x) = x - 4$. Which statements are true?

Select all that apply.

One root of $f(x)$ is -4 .

One root of $f(x)$ is 29 .

If $f(x)$ is divided by $g(x)$, the remainder is 29 .

$g(x)$ is a factor of $f(x)$.

$g(x)$ is not a factor of $f(x)$.

4 | 2 -1 1
 | 8 28
 | 2 7 (29)

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Which expression is equivalent to $162x^4 - 144x^2 + 32$? $2(81x^4 - 72x^2 + 16)$

Select all that apply. $2(9x^2 - 4)^2$

$2(81x^2 - 72x + 16)$

$2(81x^2 + 4)(81x^2 + 4)$

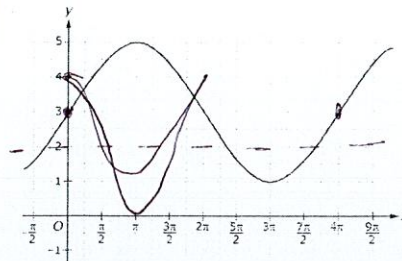
$2(81x^2 - 4)(81x^2 + 4)$

$2(9x^2 - 4)(9x^2 - 4)$

$2(9x^2 + 4)(9x^2 + 4)$

$2(3x + 2)^2(3x - 2)^2$

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The graph of the function $f(x)$ is shown in the coordinate plane above, and $g(x) = 2\cos(x) + 2$. Answer each of the following questions about $f(x)$ and $g(x)$.

Part A

How do the maximum values of the two functions compare?

$g(x)$ has a maximum value of 4

Part B

How do the minimum values of the two functions compare?

$f(x)$ has a max of 5

Part C

How do the amplitudes of the two functions compare?

$f(x)$ has a min of 1
 $g(x)$ has a max of 0

Part D

How do the periods of the two functions compare?

$f(x)$ and $g(x)$ have an amplitude of 2

$f(x)$ has a period of 4π
 $g(x)$ has a period of 2π