

SAT Math Prep Course Packet

Course Outline

Day 1

- Introduction
- Test Format
- General Strategies
- Diagnostic Test Questions
- Math Topics: Linear Equations, Systems, Inequalities
- Practice
- Homework: Practice Test #1

Day 2

- Practice Test #1 Questions
- Math Topics: Problem Solving, Ratios, Proportions, Scatterplots, Probability, Statistics
- Practice
- Homework: Practice Test #2

Day 3

- Practice Test #2 Questions
- Math Topics: Exponents, Polynomials, Radicals, Advanced Equations, Functions
- Practice
- Homework: Practice Test #3

Day 4

- Practice Test #3 Questions
- Math Topics: Quadratics, Imaginary Numbers
- Practice
- Homework: Practice Test #4

Day 5

- Practice Test #4 Questions
- Math Topics: Lines, Angles, Triangles, Similarity, Congruence, Proofs, Circles, Solids, Trigonometry
- Practice
- Course Evaluation

All practice tests, course materials, and solutions will be posted on my school website.
Go to VMHS.net, click on Teachers, Click on Alan Tupaj, Click on SAT Math Prep Course.

Day 1

I. Introduction

Student Info – Name, School, Previous Score, Goal, College choices
Personal Background
Course format

II. SAT Math Test Format

| Section | Questions | Time |
|---------|-------------------------------------------------------------------------------|------------|
| 3 | 20 Questions – 15 multiple choice, 5 grid in answers No Calculator Allowed | 25 minutes |
| 4 | 38 Questions – 30 multiple choice, 8 grid in answers Calculator Allowed | 55 minutes |

No penalty for guessing

III. General Breakdown of Questions

Categories of questions:

1. Algebra I (19 questions)
2. Problem Solving / Data Analysis (17 questions)
3. Advanced Math (16 questions)
4. Geometry (6 questions)

No logarithms. All other Algebra 2 topics are included along with some trigonometry

IV. General Strategies

1. Read and re-read the problem carefully. Don't rush the reading.
2. Identify what the problem is asking for. Don't answer x if the problem asks for $2x$.
3. Write in the test booklet. Draw and label diagrams if not to scale.
4. Pace yourself – Approximately 1 minute per problem on section 3 and 1.5 minutes per problem on section 4.
5. Don't leave any problem blank
6. Know the rules for grid-ins.
7. Look for a known relationship, plug in given values, and solve for missing value
8. Identify a specific algebra skill. Factoring, simplifying, equation solving
9. Work backwards. Plug in the answer choices.

V. How to Prepare

1. Get LOTS of problems wrong and learn what you did wrong
Identify the type of mistake:
 - a. Arithmetic
 - b. Algebra
 - c. Lack of knowledge (don't know the relationship)
 - d. Mis-read question
 - e. Did not answer the question
2. Master the math skills. Know all relationships.
3. Practice under time constraints.
4. Plan on three tests dates: First time – Practice, Second time – Real, Third time – Goal

Questions: Email me at amtupaj@murrieta.k12.ca.us

VI. 10 Good Websites: (Based on old SAT)

<http://www.erikthered.com/tutor/>

Good summary of strategies. Lots of practice broken down into smaller categories. Detailed answers and hints.

<http://www.majortests.com/sat/>

Lots of practice tests with explanations for wrong answers.

<https://sat.collegeboard.org/practice/sat-practice-questions-math/math-concepts>

Collegeboard creates the test, so practice questions will be most similar to the real questions.

<https://www.khanacademy.org/test-prep/sat>

Video instruction to go along with practice

<http://www.proprofs.com/sat/study-guide/>

Study guides for specific topics along with practice tests

<http://www.4tests.com/sat>

Practice tests with answers and explanations

<http://magoosh.com/sat/2014/how-to-study-sat-math/>

Good strategies, no real practice.

<http://www.veritasprep.com/sat-prep-algebra-resources-galore/>

A collection of math skill review sites

<http://domeprep.com/sat-act-prep/sat-course/on-demand/study-guides>

An online prep book looking at each math skill. No practice problems.

<http://www.brightstorm.com/test-prep/sat/sat-math/>

Video instruction on SAT Math topics

Day 1: Linear Equations, Systems, Inequalities Notes

1.

| x | y |
|-----|-----|
| -1 | 7 |
| 0 | 5 |
| 1 | 3 |
| 2 | 1 |

If graphed, the ordered pairs in the table above would form a line. Where would this line intersect the x -axis?

- (A) $-2\frac{1}{2}$
- (B) $-\frac{1}{2}$
- (C) $2\frac{1}{2}$
- (D) 5

2.

Johanna picked 3 pounds of strawberries at a "pick-your-own" patch. At this particular patch, the cost is \$1.50 for the pail and \$3.99 per pound of strawberries picked. If a linear equation is created to represent the situation and written in the form $y = mx + b$, which piece of the equation would the value 13.47 in this scenario most likely represent?

- (A) b
- (B) m
- (C) x
- (D) y

3.

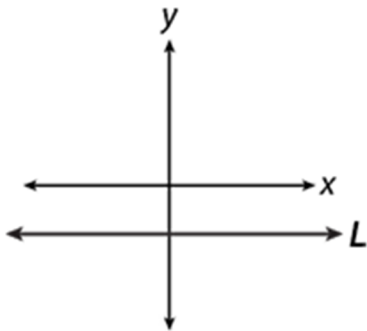
If $y = 12 - x$ and $\frac{3y}{4} + 11 = \frac{-x}{2}$, what is the value of $\frac{x}{5} + \frac{y}{4}$?

- (A) -1
- (B) $\frac{75}{4}$
- (C) $\frac{19}{4}$
- (D) 33

4. Calculator

Rasha volunteers at a charity that helps feed the homeless. He collects donations and then uses the money to buy food for care packages. This week, he collected \$145. Each care package will include canned vegetables and bags of rice in the ratio 3:1. The cans cost \$0.89 each, and the bags of rice cost \$3.49 each. Using the given ratio, what is the maximum number of complete vegetable/rice care packages Rasha can make?

5.

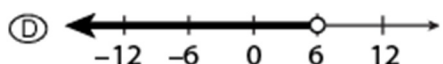
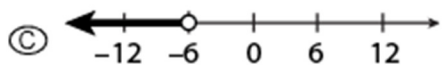
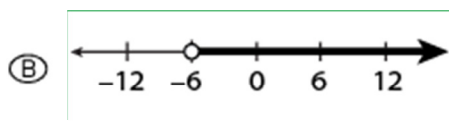


Line L shown in the graph could be the graph of which equation?

- (A) $x + y = -2$
- (B) $x + y = 0$
- (C) $x + y - 2 = x$
- (D) $x + y + 2 = x$

6.

Which of the following number lines represents the solution to the inequality $3x + 29 > 5 - x$?



7.

At the grocery store, Gigi buys apples, a magazine, and a gallon of milk. The apples are priced per pound. In her state, there is no sales tax on food. If the total cost of her items is given by the function $C(p) = 1.89p + 1.07(3.99) + 4.49$, then the term $1.07(3.99)$ most likely represents

- (A) the cost of one gallon of milk.
- (B) the per-pound cost of the apples.
- (C) the cost of the magazine, including tax.
- (D) the cost of the magazine, not including tax.

8.

When a homeowner hires a contractor to renovate a bathroom, the homeowner is charged for both labor and materials. By law, the contractor can charge sales tax on the materials, but not on the labor. If the contractor quotes the homeowner \$3,000 for materials and \$40 per hour for labor, and sales tax in the homeowner's state is 5.5%, which equation represents the total cost for the bathroom renovation if it takes the contractor h hours to complete the job?

- (A) $c = (40h + 3,000)(1.055)$
- (B) $c = 1.055(40 + 3,000)h$
- (C) $c = 40h(1.055) + 3,000$
- (D) $c = 40h + 1.055(3,000)$

9.

A picture framing shop sells ready-made frames and also does custom framing using different kinds and widths of wood or metal. The shop has a three-day sale. During the sale, for an 11-inch \times 14-inch frame, a ready-made frame costs \$12 and a custom frame costs \$30. Over the course of the three days, the shop sells ninety-two 11 \times 14 frames and collects \$1,788. Solving which system of equations would yield the number of 11 \times 14 ready-made frames r and the number of 11 \times 14 custom frames c that the shop sold during the three-day sale?

(A)
$$\begin{cases} r + c = 92 \\ 12r + 30c = \frac{1,788}{3} \end{cases}$$

(B)
$$\begin{cases} r + c = 1,788 \\ 12r + 30c = 92 \times 3 \end{cases}$$

(C)
$$\begin{cases} r + c = 1,788 \\ 12r + 30c = 92 \end{cases}$$

(D)
$$\begin{cases} r + c = 92 \\ 12r + 30c = 1,788 \end{cases}$$

10. Calculator

| City | Cost per Square Foot |
|---------------|----------------------|
| Detroit | \$62.45 |
| Atlanta | \$74.19 |
| New York City | \$288.58 |
| San Francisco | \$420.99 |

In real estate, location is often the number one determinant of home prices. The table above shows the average price per square foot of houses in four cities. Assuming an average home size of 1,500 to 2,000 square feet, which inequality represents how much more in dollars a house in New York City would cost than in Detroit?

- (A) $x \geq 226.13$
(B) $62.45 \leq x \leq 288.58$
(C) $93,675 \leq x \leq 432,870$
(D) $339,195 \leq x \leq 452,260$

Day 1: Linear Equations, Systems, Inequalities Practice

1.

A publishing company ships books to schools, some of which are hardback textbooks and some are paperback workbooks. Each shipping box can hold a maximum of 20 textbooks or 64 workbooks. Each textbook takes up 192 cubic inches of space, and each workbook takes up 60 cubic inches of space. One box can hold a maximum of 3,840 cubic inches. The shipping department is packing a box containing both types of books. Which of the following systems of inequalities can the department use to determine how many textbooks, t , and workbooks, w , can be shipped in one box?

$$t \leq 20$$

(A) $w \leq 64$

$$60t + 192w \leq 3,840$$

$$t \geq 20$$

(B) $w \geq 64$

$$192t + 60w \geq 3,840$$

$$t \leq 20$$

(C) $w \leq 64$

$$192t + 60w \leq 3,840$$

$$t \leq 192$$

(D) $w \leq 60$

$$20t + 64w \leq 3,840$$

2.

Which of the following does not represent a linear relationship?

(A)

| | | | | | |
|----------|----|----|----|-----|-----|
| x | -1 | -4 | -7 | -10 | -13 |
| y | 8 | 6 | 4 | 2 | 0 |

(B)

| | | | | | |
|----------|----|----|---|----|----|
| x | -3 | -1 | 1 | 3 | 5 |
| y | 5 | 3 | 1 | -1 | -3 |

(C)

| | | | | | |
|----------|----|----|----|----|----|
| x | 1 | 2 | 3 | 4 | 5 |
| y | -5 | -5 | -5 | -5 | -5 |

(D)

| | | | | | |
|----------|----|----|---|---|---|
| x | -2 | -1 | 0 | 1 | 2 |
| y | 4 | 1 | 0 | 1 | 4 |

3.

$$\begin{cases} Ax - 2y = 18 \\ Bx + 6y = 26 \end{cases}$$

If the graphs of the lines in the system of equations above intersect at $(4, -1)$, what is the value of $\frac{B}{A}$?

(A) -3

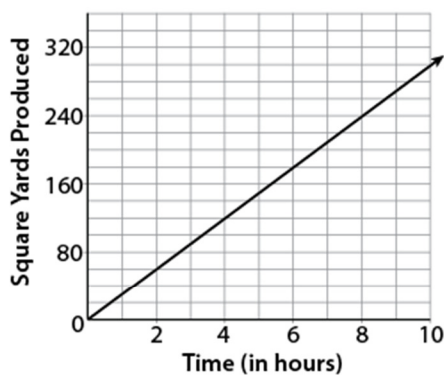
(B) $-\frac{1}{3}$

(C) $\frac{1}{2}$

(D) 2

4.

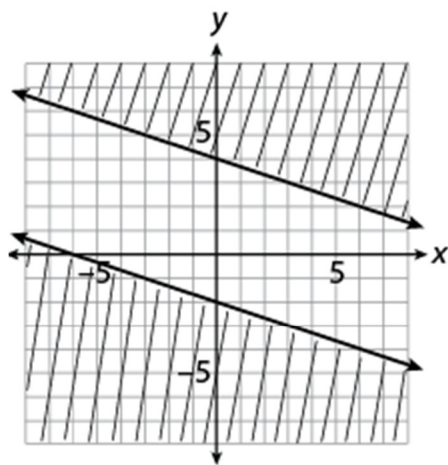
Wool-Polyester Blend Production



The figure above shows the rate at which a textile machine can produce a wool-polyester blend fabric. To produce a 100% polyester fabric, the same machine can produce 40 square yards per hour. Given that the company needs to fill an order for 2,400 square yards of each type of fabric, which of the following statements is true?

- (A) It will take half as long to make the blended fabric as the 100% polyester fabric.
 (B) It will take twice as long to make the blended fabric as the 100% polyester fabric.
 (C) It will take 20 more hours to make the blended fabric than the 100% polyester fabric.
 (D) It will take 20 fewer hours to make the blended fabric than the 100% polyester fabric.

5.



Which of the following systems of inequalities could be represented by the graph shown?

(A)
$$\begin{cases} 3x - y \geq 4 \\ 3x - y \leq -2 \end{cases}$$

(B)
$$\begin{cases} 3x + y \geq 4 \\ 3x + y \leq -2 \end{cases}$$

(C)
$$\begin{cases} x - 3y \geq 12 \\ x - 3y \leq -6 \end{cases}$$

(D)
$$\begin{cases} x + 3y \geq 12 \\ x + 3y \leq -6 \end{cases}$$

6.

If $0.2x + 1.8 = 3 - 0.6x$, what is the value of x ?

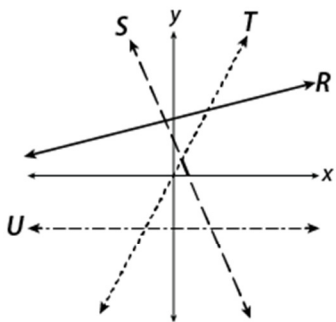
7.

| Equation 1 | |
|------------|-----|
| x | y |
| 5 | -8 |
| 4 | -5 |
| 3 | -2 |
| 2 | 1 |

| Equation 2 | |
|------------|-----|
| x | y |
| -8 | 3 |
| -6 | 4 |
| -4 | 5 |
| -2 | 6 |

The tables above represent data points for two linear equations. If the two equations form a system, what is the x -coordinate of the solution to that system?

8.



Which of the following lists correctly orders the lines in the figure above according to their slopes, from least to greatest?

- (A) R, T, S, U
- (B) S, U, R, T
- (C) S, R, U, T
- (D) U, S, R, T

9. Calculator

| Price per Pencil | Projected Number of Units Sold |
|------------------|--------------------------------|
| \$0.20 | 150,000 |
| \$0.25 | 135,000 |
| \$0.30 | 120,000 |
| \$0.35 | 105,000 |
| \$0.40 | 90,000 |
| \$0.45 | 75,000 |

Generally, the price of an item is a good indicator of how many units of that item will be sold. The lower the price, the more units will be sold. A marketing department develops a table showing various price points and the projected number of units sold at that price point. Which of the following represents the linear relationship shown in the table, where x is the price and y is the number of units sold?

- (A) $y = 0.03x + 150,000$
- (B) $y = 300,000x + 75,000$
- (C) $y = -300,000x + 90,000$
- (D) $y = -300,000x + 210,000$

10. Calculator

A mailing supply store sells small shipping boxes in packs of 8 or 20. If the store has 61 packs in stock totaling 800 small shipping boxes, how many packs have 20 boxes in them, assuming all the packs are full?

- (A) 26
- (B) 32
- (C) 35
- (D) 40

Day 2: Problem Solving, Statistics, Probability, Proportions, Percents Notes

1. Calculator

A student is doing a scale drawing of a woolly mammoth on a piece of poster board for her presentation on the last ice age. She was surprised to find that the woolly mammoth, reaching a height of only about 10 feet, 6 inches, was actually smaller than today's African elephant. Even more surprising is the fact that the woolly mammoth's tusks averaged 11.5 feet in length. If the student draws the mammoth 14 inches tall on her poster, approximately how many inches long should she make the tusks?

- (A) 12.78
- (B) 15.0
- (C) 15.33
- (D) 16.1

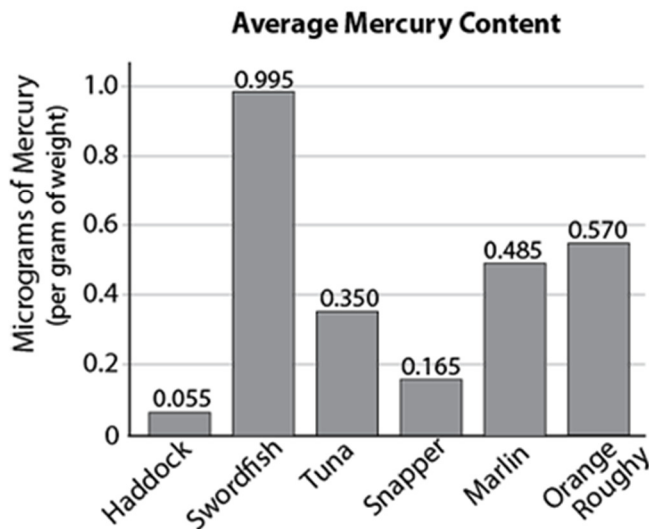
2. Calculator

In an effort to decrease reliance on fossil fuels, some energy producers have started to utilize renewable resources. One such power plant uses solar panels to create solar energy during the day and then shifts to natural gas at night or when there is cloud cover. One particularly bright morning, the company increases the amount of its power typically generated by solar panels by 60%. During a cloudy spell, it decreases the amount by 30%, and then when the sun comes back out, it increases the amount again by 75% before shutting the panels down for the night. What is the net percent increase of this company's reliance on solar panels during that day?

- (A) 75%
- (B) 96%
- (C) 105%
- (D) 165%

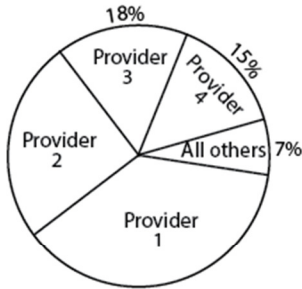
3. Calculator

Mercury is a naturally occurring metal that can be harmful to humans. The current recommendation is for humans to take in no more than 0.1 microgram for every kilogram of their weight per day. Fish generally carry high levels of mercury, although certain fish have higher mercury content than others. Fish, however, are healthy sources of many other nutrients, so nutritionists recommend keeping them in the human diet. The figure below shows the average mercury content of several types of fish.



If a person weighs 82 kilograms, how many grams of snapper can he safely consume per day? Round your answer to the nearest gram.

4. Calculator



A company's market share is the percent of consumers who utilize the services or buy the products of that company. The pie chart above shows the different market shares of cable providers in a certain region. If the ratio of the market shares of Provider 1 to Provider 2 is 3:2, what is Provider 1's market share?

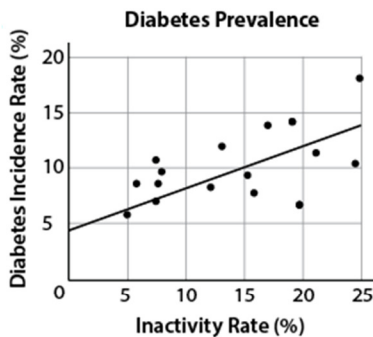
- (A) 24%
- (B) 30%
- (C) 36%
- (D) 42%

5. Calculator

Water is vital to human health. An average person should consume approximately 2.5 ounces of water per hour. However, because of the salt in it, seawater actually dehydrates the human body and should not be consumed. This is why boats must carry a supply of fresh water when embarking on long trips. Suppose a sailboat is traveling at an average speed of 4 nautical miles per hour with 3 people on board and the trip is 232 nautical miles. What is the minimum number of ounces of water the boat should stock before leaving?

- (A) 69.6
- (B) 145
- (C) 435
- (D) 1,113.6

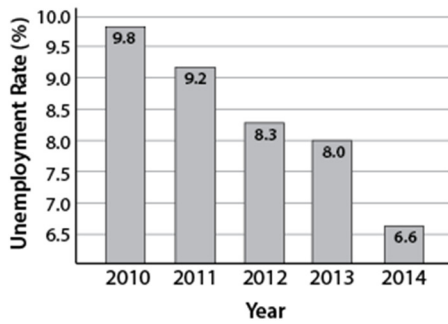
6.



Increased physical activity has been linked to a lower incidence rate of diabetes. The scatterplot above shows the relationship between the percent of people in a certain country whose daily activity qualifies them as "inactive" and the incidence rate of diabetes in that country. The line of best fit for the data is also shown. Which of the following best represents the meaning of the y-intercept of the line of best fit in the context of this question?

- (A) The predicted incidence rate of diabetes when the entire country is considered active
- (B) The predicted incidence rate of diabetes when the entire country is considered inactive
- (C) The predicted percent of people who will be active when the incidence rate of diabetes is 0%
- (D) The predicted percent of people who will be inactive when the incidence rate of diabetes is 0%

7. Calculator

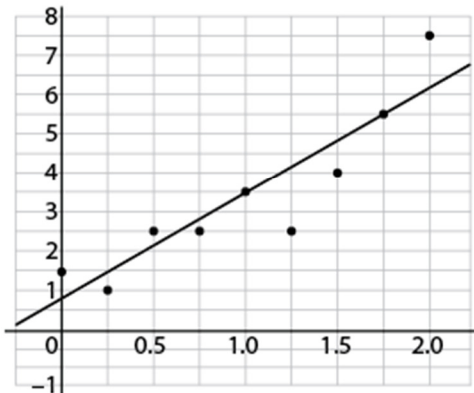


The bar graph shows the percent of the United States population that was unemployed as of January 1 on each of the years shown. A governmental agency wants to use the 5-year mean of the data to estimate how many people were unemployed in a certain geographic area between 2010 and 2014. If the total adult population of the area was 250,000, approximately how many adults were unemployed in that area during the indicated time period?

- (A) 16,950
- (B) 20,150
- (C) 20,950
- (D) 104,750

8.

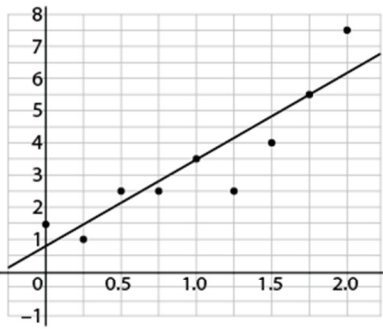
Use the data in the scatterplot and the line of best fit shown to answer the following question.



Which of the following values most accurately reflects the average rate of change of the data based on the line of best fit?

- (A) $\frac{3}{8}$
- (B) $\frac{3}{4}$
- (C) $\frac{4}{3}$
- (D) $\frac{8}{3}$

9.



According to the graph, the data has been modeled using a line of best fit. Another researcher thinks that an exponential model may be a better fit. The table below shows the researcher's results after using a graphing calculator to perform a linear regression and an exponential regression on the data.

| LinReg | ExpReg |
|-------------------|--------------------|
| $y = ax + b$ | $y = a \times b^x$ |
| $a = 2.7$ | $a = 1.251327$ |
| $b = .68888889$ | $b = 2.299749$ |
| $r^2 = .81876039$ | $r^2 = .84304281$ |
| $r = .9048538$ | $r = .9181736$ |

Which of the following best explains which regression model is a better fit and why?

- (A) A linear model is a much better fit because its value of a is considerably higher.
- (B) A linear model is a slightly better fit because its value of r is slightly smaller.
- (C) An exponential model is a much better fit because its value of a is much closer to 1.
- (D) An exponential model is a slightly better fit because its value of r is slightly closer to 1.

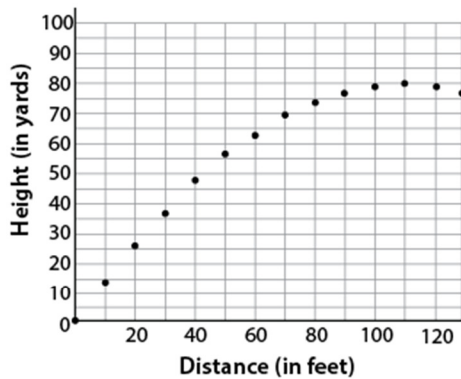
10. Calculator

The Consumer Price Index (CPI) is a weighted average of the cost of certain categories of goods and services in the United States. It is one of the most widely used measures of inflation. According to the U.S. Census Bureau, the CPI was 130.7 in 1990, and was 218.1 in 2010. If the CPI continues to experience the same percent increase over the next 20 years, approximately what will the CPI be in 2030?

- (A) 145.8
- (B) 305.5
- (C) 363.9
- (D) 408.7

Day 2: Problem Solving, Statistics, Probability, Proportions, Percents Practice

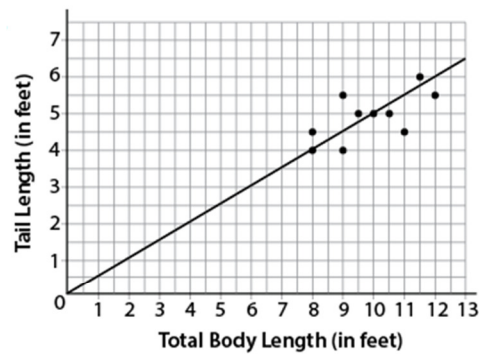
1.



The figure above shows part of the path of a planned roller coaster hill. What is the sum, in feet, of the vertical height and the horizontal distance that the roller coaster will travel while on this particular hill?

- (A) 220
- (B) 300
- (C) 460
- (D) 900

2.



The Florida Department of Wildlife caught and tagged 10 adult female alligators as part of an effort to protect this endangered species. They took various measurements and readings related to body size and health. The total body length is plotted against the tail length in the scatterplot shown above, along with a line of best fit. Which of the following equations best models the data?

- (A) $y = 0.5x$
- (B) $y = 2x$
- (C) $y = 0.4x + 1$
- (D) $y = 0.6x - 1$

3. Calculator

The American political system is largely a twoparty system. In fact, only six candidates who were not associated with either the Republican or the Democratic Party have been elected governor in any state since 1990. In one such election, the ratio of votes received for the Independent candidate to the Democratic candidate to the Republican candidate was approximately 19:18:13. If 510,000 votes were cast in the election, how many more votes were cast for the Independent candidate than for the Republican candidate?

- (A) 6,000
- (B) 10,200
- (C) 51,200
- (D) 193,800

4. Calculator

| Selection Method | Number of States |
|---------------------------|------------------|
| Election | 22 |
| Gubernatorial Appointment | 11 |
| Legislative Appointment | 2 |
| Missouri Plan | 15 |

There are four ways in which state judges are selected for their positions. One is by election, another is appointment by the governor (usually with the confirmation by the state legislature), and a third is appointment by the state legislature. The final way is a hybrid of the last two, called the Missouri Plan, in which a nonpartisan legislative committee recommends a list of candidates and the governor chooses from this list. The table above shows the number of states that engage in each process for the highest court of the state, usually called the state Supreme Court. What percent of states select judges using the Missouri Plan?

- (A) 17%
- (B) 30%
- (C) 33%
- (D) 43%

5. Calculator

A dendrologist (a botanist who studies trees exclusively) is examining the way in which a certain tree sheds its leaves. He tracks the number of leaves shed each day over the period of a month, starting when the first leaf is shed. He organizes the data in a scatterplot and sees that the data can be modeled using an exponential function. He determines the exponential model to be $f(x) = 6(1.92)^x$, where x is the number of days after the tree began to shed its leaves. What does the value 1.92 in the function tell the dendrologist?

- (A) The number of leaves shed almost doubles each day.
- (B) The number of leaves shed almost doubles every six days.
- (C) The number of leaves left on the tree is reduced by about 92% each day.
- (D) The number of leaves left on the tree is reduced by about 92% every six days.

6 and 7. Calculator

Plants are capable of cross-pollinating with related but different plants. This creates a hybrid. Sometimes, a hybrid plant is superior to the two different plants from which it was derived. This is "hybrid vigor." Scientists can examine the DNA of a plant to see if it is a hybrid. This can be information because if the plant appears superior, it would be beneficial to develop more of these. An agricultural scientist examines an orchard that has several types of apple trees and orange trees which ones are hybrids. Some of the information she collected is shown in the table below.

| | Apple Trees | Orange Trees | Total |
|------------|-------------|--------------|-------|
| Hybrid | | | 402 |
| Non-hybrid | | 118 | |
| Totals | | | 628 |

6. Based on the data, if 45% of the apple trees are not hybrids, how many apple trees are hybrids?

- (A) 50
- (B) 132
- (C) 226
- (D) 240

7.

The scientist wants to study the orange trees to check for hybrid vigor. If she chooses one orange tree at random, what is the probability that it will be a hybrid?

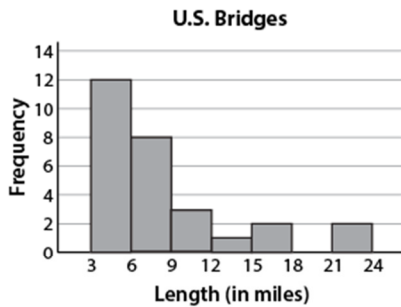
- (A) $\frac{59}{194}$
- (B) $\frac{97}{157}$
- (C) $\frac{135}{314}$
- (D) $\frac{135}{194}$

8. Calculator

Mount Fuji in Japan was first climbed by a monk in 663 ad and subsequently became a Japanese religious site for hundreds of years. It is now a popular tourist site. When ascending the mountain, tourists drive part of the distance and climb the rest of the way. Suppose a tourist drove to an elevation of 2,390 meters and from that point climbed to the top of the mountain, and then descended back to the car taking the same route. If it took her a total of 7 hours to climb up and back down, and she climbed at an average rate of 264 vertical meters per hour going up and twice that going down, approximately how tall is Mount Fuji?

- (A) 1,386 meters
- (B) 2,772 meters
- (C) 3,776 meters
- (D) 5,172 meters

9. Calculator



The Lake Pontchartrain Causeway Bridge in Louisiana is the longest bridge in the United States, at 23.83 miles long. The histogram above shows the distribution of the lengths, in miles, of 28 of the longest bridges in the United States, including Lake Pontchartrain Causeway Bridge. Which of the following could be the median length of the 28 bridges represented in the histogram?

- (A) 5.9
- (B) 7.9
- (C) 9.2
- (D) 9.9

10. Calculator

In the United States, the original full retirement age was 65. The retirement age has since been pushed to 66 and will soon move to 67, as life expectancies go up. The Social Security Administration periodically conducts studies regarding retirement age. One such study focused on whether or not retiring early lowers a person's life expectancy. The study found a weak positive correlation between retirement age and life expectancy. If data from the study were graphed in a scatterplot, which of the following statements would be true?

- (A) The slope of the line of best fit would be a large positive number.
- (B) The slope of the line of best fit would be a negative number close to 0.
- (C) The data points would follow, but not closely, an increasing line of best fit.
- (D) The data points would be closely gathered around an increasing line of best fit.

Day 3: Exponents, Radicals, Polynomials, Advanced Equations, Functions Notes

1. Calculator

If $M = 3x^2 + 9x - 4$ and $N = 5x^2 - 12$, what is $2(M - N)$?

- (A) $-2x^2 + 9x + 8$
- (B) $-4x^2 + 18x - 32$
- (C) $-4x^2 + 18x + 16$
- (D) $8x^2 + 9x - 16$

2.

If h is a function defined over the set of all real numbers and $h(x - 4) = 6x^2 + 2x + 10$, then which of the following defines $h(x)$?

- (A) $h(x) = 6x^2 - 2x + 114$
- (B) $h(x) = 6x^2 - 46x + 98$
- (C) $h(x) = 6x^2 + 2x + 98$
- (D) $h(x) = 6x^2 + 50x + 114$

3.

Which of the following functions has a domain of $x \geq 2$?

- (A) $f(x) = -x^2 + 2$
- (B) $g(x) = -\sqrt{x - 2}$
- (C) $h(x) = -\sqrt{x} + 2$
- (D) $k(x) = -|x - 2|$

4.

$$16^{\frac{3}{2}}$$

Which of the following represents the number shown above as an integer?

- (A) 4
- (B) 12
- (C) 48
- (D) 64

5.

$$g(x) = \begin{cases} x^2 - 1, & \text{if } x \leq 0 \\ \frac{x^2}{3} + 1, & \text{if } 0 < x \leq 3 \\ 5x + 3, & \text{if } x > 3 \end{cases}$$

For the piecewise defined function $g(x)$ shown above, what is the value of $g(2)$?

6.

$$\frac{x}{x-1} - \frac{2}{x} = \frac{1}{x-1}$$

What is one possible solution to the rational equation shown above?

7.

$$(36x^4y^7)^{\frac{1}{2}}$$

Which of the following is equivalent to the expression given above?

(A) $\frac{36x^4y^7}{2}$

(B) $6xy^2\sqrt{y}$

(C) $6x^2y^3\sqrt{y}$

(D) $(36x^4y^7)^{-2}$

8.

Given the function $f(x) = \frac{1}{4}x - 2$, what domain value corresponds to a range value of $-\frac{5}{3}$?

(A) $-\frac{29}{12}$

(B) $\frac{4}{3}$

(C) $\frac{7}{3}$

(D) $\frac{29}{12}$

9.

$$T = 2\pi\sqrt{\frac{m}{k}}$$

When a spring is pressed tightly between two objects, it remains still. When one or both of those objects is disturbed, the spring starts to move. The equation above can be used to find the time period T in which a mass m , attached to a spring, makes a single oscillation (going all the way down and then back up). The variable k is a constant. Which of the following equations could be used to find the mass of the object?

(A) $m = \frac{2\pi k}{T^2}$

(B) $m = \frac{kT^2}{4\pi^2}$

(C) $m = \frac{T^2}{4\pi^2 k}$

(D) $m = \sqrt{\frac{T}{2\pi k}}$

10.

$$\frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$$

In electronic circuits, resistors are often paired to manage the flow of the electrical current. To find the total resistance of a pair of parallel resistors, electricians use the formula shown above, where R_1 is the resistance of the first resistor and R_2 is the resistance of the second resistor. Which of the following is another way to represent this formula?

(A) $\frac{R_1 R_2}{R_1 + R_2}$

(B) $\frac{R_1 + R_2}{R_1 R_2}$

(C) $\frac{1}{R_2} - \frac{1}{R_1}$

(D) $R_1 + R_2$

Day 3: Exponents, Radicals, Polynomials, Advanced Equations, Functions Practice

1.

$$a^{\frac{2}{6}}$$

Which of the following is equivalent to the expression above?

- (A) $\sqrt[3]{a}$
- (B) $\sqrt{3a}$
- (C) $\frac{a}{3}$
- (D) $\frac{2}{a^6}$

2.

A nutritionist is studying the effects of nutritional supplements on athletes. She uses the function $P_i(a)$ to represent the results of her study, where a represents the number of athletes who participated in the study, and P_i represents the number of athletes who experienced increased performance while using the supplements over a given period of time. Which of the following lists could represent a portion of the domain for the nutritionist's function?

- (A) $\{\dots -100, -75, -50, -25, 0, 25, 50, 75, 100 \dots\}$
- (B) $\{-100, -75, -50, -25, 0, 25, 50, 75, 100\}$
- (C) $\{0, 2.5, 5, 7.5, 10, 12.5, 15 \dots\}$
- (D) $\{0, 15, 30, 45, 60, 75 \dots\}$

3.

Which of the following expressions has the same value as $\sqrt{0.25} \times \sqrt{2}$?

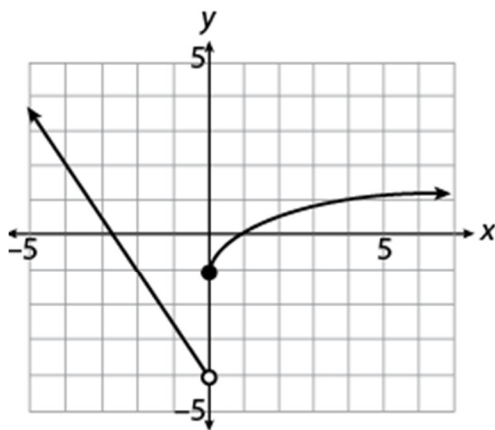
- (A) $\frac{\sqrt{2}}{4}$
- (B) $\frac{1}{2}$
- (C) $\frac{\sqrt[4]{2}}{2}$
- (D) $\frac{\sqrt{2}}{2}$

4.

Given the polynomial $6x^4 + 2x^2 - 8x - c$, where c is a constant, for what value of c will $\frac{6x^4 + 2x^2 - 8x - c}{x + 2}$ have no remainder?

- (A) -120
- (B) -60
- (C) 60
- (D) 120

5.



Which of the following piecewise functions could have been used to generate the graph above?

(A)
$$g(x) = \begin{cases} -\frac{3}{2}x - 4, & \text{if } x < 0 \\ \sqrt{x-1}, & \text{if } x \geq 0 \end{cases}$$

(B)
$$g(x) = \begin{cases} -\frac{3}{2}x - 4, & \text{if } x < 0 \\ \sqrt{x-1}, & \text{if } x \geq 0 \end{cases}$$

(C)
$$g(x) = \begin{cases} -\frac{3}{2}x - 4, & \text{if } x < 0 \\ \sqrt{x+1}, & \text{if } x > 0 \end{cases}$$

(D)
$$g(x) = \begin{cases} -\frac{2}{3}x - 4, & \text{if } x < 0 \\ \sqrt{x+1}, & \text{if } x \geq 0 \end{cases}$$

6.

$$18 - \frac{(3x)^{\frac{1}{2}}}{2} = 15$$

What value of x satisfies the equation above?

7.

If $g(x) = 2x^3 - 5x^2 + 4x + 6$, and P is the point on the graph of $g(x)$ that has an x -coordinate of 1, then what is the y -coordinate of the corresponding point on the graph of $g(x - 3) + 4$?

8. Calculator

$$-\frac{9}{2}x^{10} - \frac{3}{2}x^9 + \frac{15}{2}x^8$$

Which of the following is equivalent to the expression above?

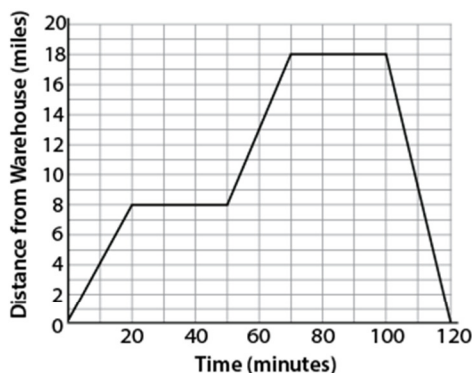
(A) $-\frac{3}{2}x^8(3x^2 + x - 5)$

(B) $-\frac{1}{2}x^8(9x^2 + 3x - 5)$

(C) $\frac{3}{2}x^8(-3x^2 + x + 5)$

(D) $3x^8(-3x^2 - x + 5)$

9. Calculator



The graph above shows a delivery truck's distance from the company's warehouse over a two-hour period, during which time the delivery people made two deliveries and then returned to the warehouse. Based on the graph, which of the following statements could be true?

- (A) Each delivery took 30 minutes to complete, not including driving time.
- (B) The location of the second delivery was about 70 miles from the warehouse.
- (C) The truck traveled about 18 miles from the time it left the warehouse until it returned.
- (D) The second delivery was about 18 miles farther from the warehouse than the first delivery.

10. Calculator

$$\left(5x^4 - \frac{1}{4}x^3 + 3x\right) \div \frac{1}{2}x$$

What is the result of dividing the two expressions above?

(A) $\frac{5}{2}x^3 - \frac{1}{8}x^2 + \frac{3}{2}$

(B) $\frac{5}{2}x^3 - 2x^2 + \frac{3}{2}x$

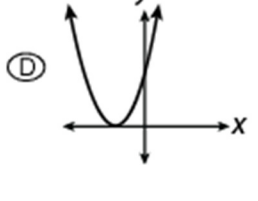
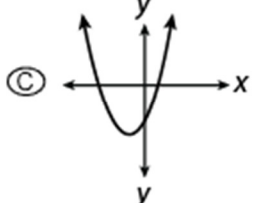
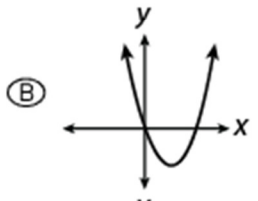
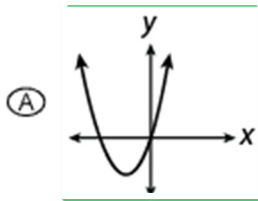
(C) $10x^3 - \frac{1}{2}x^2 + 6$

(D) $10x^3 - \frac{1}{8}x^2 + 6x$

Day 4: Quadratic Equations, Imaginary Numbers, Lines, Angles, Triangles Notes

1.

If $a = 0$ and $b < 0$, then which of the following could be the graph of $f(x) = (x - a)(x - b)$?



2.

Which of the following are solutions to the quadratic equation $(x - 2)^2 = \frac{16}{25}$?

(A) $x = \pm \sqrt{\frac{4}{5}}$

(B) $x = -\frac{4}{5}, x = \frac{4}{5}$

(C) $x = \frac{6}{5}, x = \frac{14}{5}$

(D) $x = \frac{14}{5}, x = -\frac{14}{5}$

3.

$$\frac{4 + \sqrt{-16}}{2 + \sqrt{-4}}$$

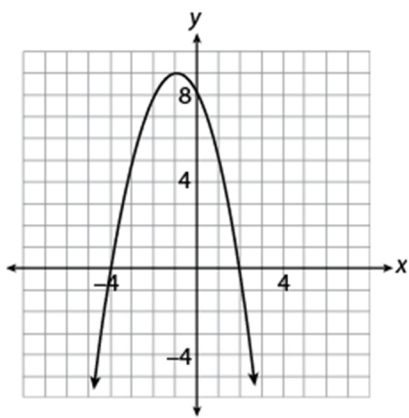
Use the definition $\sqrt{-1} = i$ to simplify the expression above.

4.

$$\frac{1}{4}i^{42} + i^{60}$$

What is the value of the complex number given above?

5.



The graph of the function $f(x) = -x^2 - 2x + 8$ is shown in the figure above. For what values of x does $f(x) = 5$?

- (A) -4 and 2
- (B) -3 and 1
- (C) -1 and 9
- (D) 5 and 8

6.

If the equation $\frac{2}{9}x^2 + \frac{8}{3}x - 7 = 3$ has solutions x_1 and x_2 , what is the product of x_1 and x_2 ?

- (A) -45
- (B) -15
- (C) -5
- (D) 3

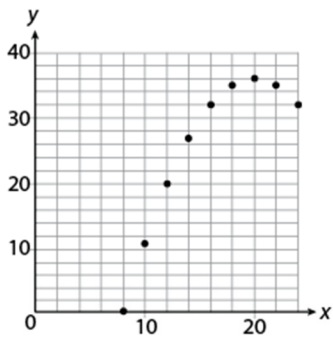
7. Calculator

$$\begin{cases} y = 3x \\ -3x^2 + 2y^2 = 180 \end{cases}$$

If (x, y) is a solution to the system of equations above, what is the value of x^2 ?

- (A) 12
- (B) 20
- (C) 60
- (D) 144

8. Calculator

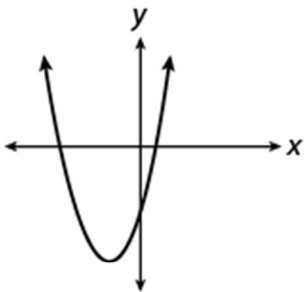


If a quadratic equation is used to model the data shown in the scatterplot above, and the model fits the data exactly, which of the following is a solution to the quadratic equation?

- (A) 28
- (B) 32
- (C) 34
- (D) 36

Day 4: Quadratic Equations, Imaginary Numbers, Lines, Angles, Triangles Practice

1.



Which of the following equations could represent the graph in the figure?

- (A) $y = x^2 - 4x - 4$
- (B) $y = x^2 + 4x - 4$
- (C) $y = x^2 - 8x + 16$
- (D) $y = x^2 + 8x + 16$

2.

$$\frac{2}{i+6} + (2+5i)$$

Which of the following expressions is equivalent to the complex number given above?

Note that $\sqrt{-1} = i$.

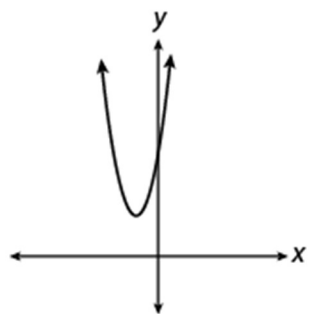
- (A) $\frac{32i+9}{i+6}$
- (B) $\frac{34i+7}{i+6}$
- (C) $\frac{32i+19}{i+6}$
- (D) $\frac{37i+14}{i+6}$

3. Calculator

Given that $\sqrt{-1} = i$, which of the following is equivalent to the sum $i^{125} + i^{125}$?

- (A) i^{14}
- (B) i^{250}
- (C) $2i^{45}$
- (D) $2i^{250}$

4. Calculator



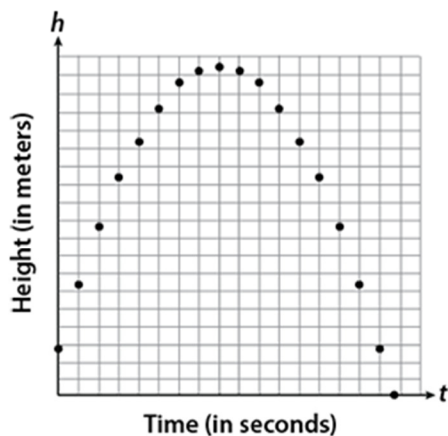
If the equation of the graph shown above is $y = 2(x + 3)^2 + 10$, what is the y -intercept of the graph?

5.

If $x^2 - 8x = 48$ and $x < 0$, what is the value of $x + 10$?

- (A) -2
- (B) 4
- (C) 6
- (D) 8

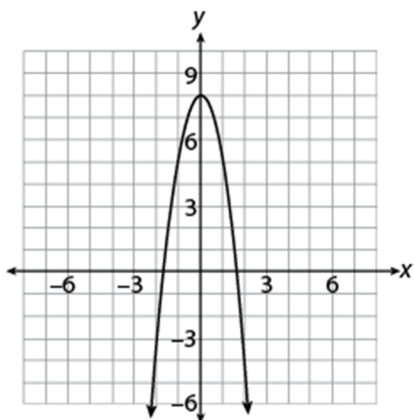
6.



A physics class is using simulation software to study water bottle rockets before attempting to build one for the National Physics Competition. Their first simulation is of a rocket without a parachute launched from the roof of the gymnasium. The scatterplot shows the approximate path of the rocket. The software program generates the equation $h = -4.9t^2 + 39.2t + 14$ to model the data, where h is the height in meters of the rocket t seconds after it was launched. What does the number 14 most likely represent in this equation?

- (A) The number of seconds the rocket was in the air
- (B) The height of the gymnasium from which the rocket was launched
- (C) The number of seconds that it took the rocket to reach its maximum height
- (D) The maximum height of the rocket

7.



Vadim graphs the equation $y = -3x^2 + 8$, which is shown in the figure above. He realizes, however, that he miscalculated and should have graphed $y = -\frac{1}{3}x^2 + 8$. How will this affect his graph?

- (A) It will change the y -intercept.
- (B) It will make the parabola open in the opposite direction.
- (C) It will make the parabola cross the x -axis closer to the origin.
- (D) It will make the parabola cross the x -axis farther from the origin.

8.

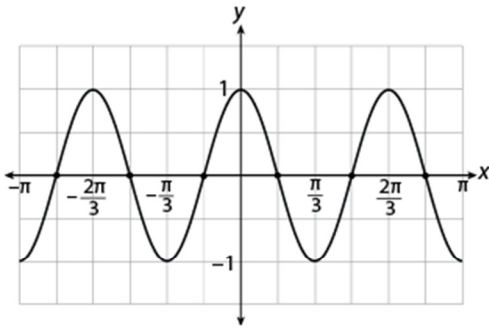
| | | | | | | |
|--------|-----|---|------|----|------|----|
| x | 1 | 2 | 3 | 4 | 5 | 6 |
| $f(x)$ | 3.5 | 0 | -2.5 | -4 | -4.5 | -4 |

The table above shows several points through which the graph of a quadratic function $f(x)$ passes. One of the x -intercepts for the graph is given in the table. What is the other x -intercept for the graph?

- (A) $(-2, 0)$
- (B) $(5, 0)$
- (C) $(8, 0)$
- (D) $(10, 0)$

Day 5: Advanced Geometry, Trigonometry Notes

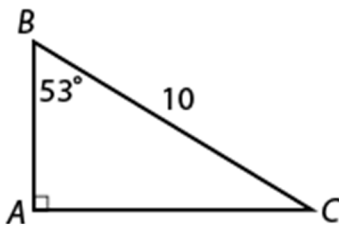
1.



The graph of $g(x) = \cos(3x)$ is shown above. Which of the following lists represents the values of x for which $g(x) = 0$?

- (A) $-180^\circ, -120^\circ, -60^\circ, 60^\circ, 120^\circ, 180^\circ$
- (B) $-165^\circ, -105^\circ, -45^\circ, 45^\circ, 105^\circ, 165^\circ$
- (C) $-150^\circ, -90^\circ, -30^\circ, 30^\circ, 90^\circ, 120^\circ$
- (D) $-120^\circ, -80^\circ, -40^\circ, 40^\circ, 80^\circ, 120^\circ$

2.



Based on the figure above, what is the approximate length of side AB ?

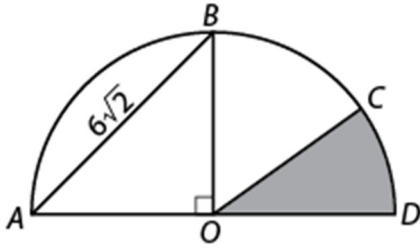
- (A) 6
- (B) 7.2
- (C) 8
- (D) 8.5

3.

In geology, the water table is the level below which the ground is saturated with water. Wells must be dug below this point to bring water up into the well. Except in cases of severe flooding, the water level in a well does not rise above the water table. Suppose a cylindrical well is 6 feet wide and 60 feet deep in an area where the water table is 40 feet below ground level. Assuming no unusual circumstances, what is the volume in cubic feet of the water in the well at any given time?

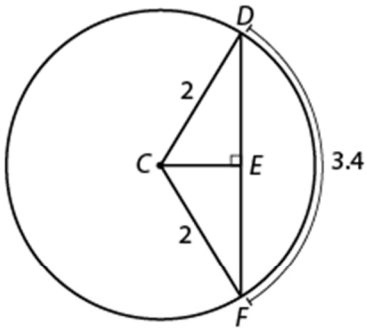
- (A) 180π
- (B) 360π
- (C) 540π
- (D) 720π

4.



If segment AD is a diameter of the circle shown above, and the length of arc CD is n , what is the area of the shaded region? Use 3.14 to approximate n and round your answer to the nearest tenth.

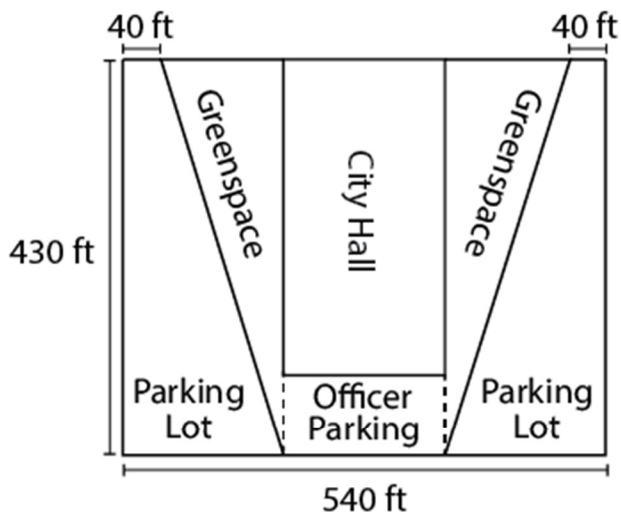
5. Calculator



Which of the following gives the length of chord DF in the figure above?

- (A) $2\cos(1.7)$
- (B) $2\sin(1.7)$
- (C) $4\cos(0.85)$
- (D) $4\sin(0.85)$

6. Calculator



Many cities try to work "greenspaces" into their city planning because living plants help filter the city's air, reducing the effects of pollution. The figure above shows the plans for a new greenspace around City Hall, which will be created by converting portions of the existing parking lots. If the width of each parking lot is the same as the width of the City Hall building, how many thousands of square feet of greenspace will there be after the conversion? Round to the nearest thousand and enter your answer in terms of thousands. (For example, enter 14,000 as 14.)

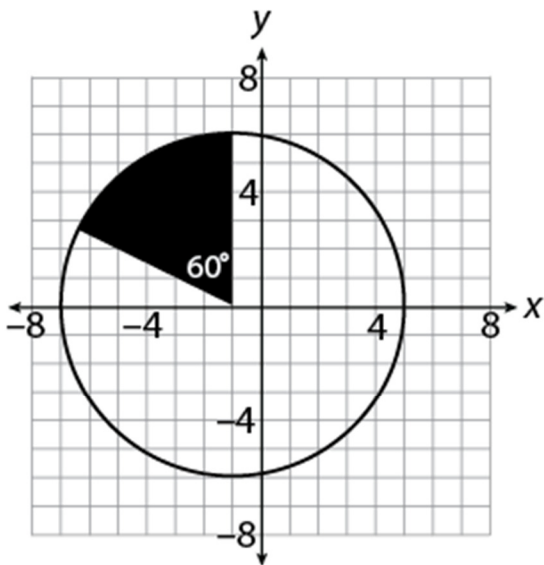
7.

If x is an angle such that $0 < x < 90^\circ$, which of the following statements is not always true?

- (A) $\cos(x) > 0$
- (B) $\cos(-x) > 0$
- (C) $\cos(x + 90^\circ) < 0$
- (D) $\cos(2x) < 0$

Day 5: Advanced Geometry, Trigonometry Practice

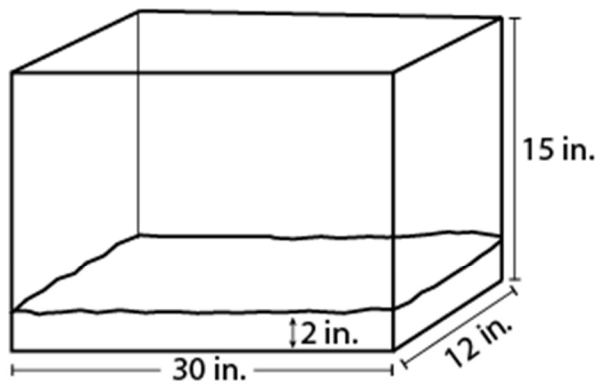
1.



What is the area of the shaded sector of the circle shown in the figure above?

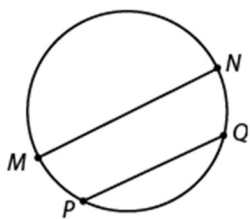
- (A) 2π
- (B) 6π
- (C) 12π
- (D) 36π

2.



The figure above shows a fish tank with sand in the bottom. If the water level is to be 3 inches below the top, how many cubic inches of water are needed to fill the tank?

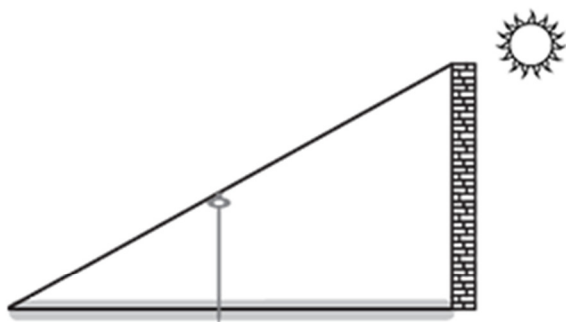
3.



The circle shown has a radius of r centimeters. If chord PQ is parallel to diameter MN , and the length of chord PQ is $\frac{3}{4}$ of the length of the diameter, what is the distance in centimeters between chords MN and PQ in terms of r ?

- (A) $\frac{\sqrt{7}}{4}r$
- (B) $\frac{\sqrt{3}}{2}r$
- (C) $\frac{1}{4}\pi r$
- (D) $\frac{3}{4}\pi r$

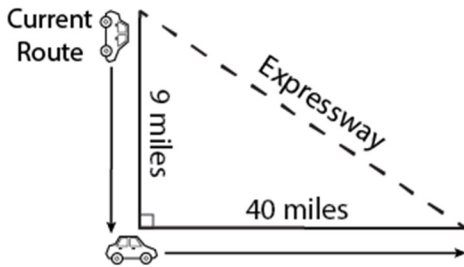
4.



Note: Figure not drawn to scale.

A toy saber is stuck at a right angle into the ground 4 inches deep. It casts a shadow that is 4 feet long. The brick wall casts a shadow three times that long. If the wall is 7 feet 6 inches tall, how many inches long is the toy saber?

5. Calculator

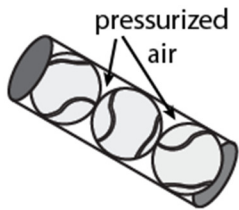


Note: Figure not drawn to scale.

The figure above shows the route that Max currently takes to work and back home every day. The city is planning to build an expressway that would cross through the city to help alleviate commuter traffic. Assuming an average gas consumption of 20 miles per gallon and a 5-day workweek, how many gallons of gas will Max save per week by taking the expressway to and from work each day instead of using his current route?

- (A) 2
- (B) 4
- (C) 8
- (D) 10.25

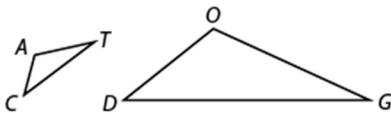
6. Calculator



Higher-quality tennis balls are typically packaged in cylindrical cans, as shown above, which are pressurized with air to keep them fresh. If the can and the tennis balls have the same diameter, 2.6 inches, what is the volume in cubic inches of the air inside the can around the tennis balls? Assume that each tennis ball is tangent to the next and that the top and bottom tennis balls are tangent to the top and bottom of the can.

- (A) 4.4π
- (B) 8.1π
- (C) 10.3π
- (D) 29.3π

7.



Note: Figure not drawn to scale.

Note: Figure not drawn to scale. If triangle CAT shown above is similar to triangle DOG , and the ratio of the length of side TC to side GD is 2:7, which of the following ratios must also be equal to 2:7?

- (A) $\overline{CA} : \overline{DG}$
- (B) $m\angle C : m\angle D$
- (C) area of $\triangle CAT$: area of $\triangle DOG$
- (D) perimeter of $\triangle CAT$: perimeter of $\triangle DOG$