Substitution Method

The Substitution method can be very useful on the SAT. The idea behind the Substitution method is that you are coming up with your own real numbers to use in the problem. For some questions you will be able to choose any value to solve the problem. For others you will only be able to choose certain numbers. However, NEVER choose the numbers 0, 1, or -1 initially as those three numbers have unique properties that may not work in every situation.

If you are using your answer choices to figure out the correct answer it is important to check ALL the answer choices as more than one choice may work. If this is the case, and two or more answer choices work, try the question with a new starting value.

Questions with Restrictions

These questions will force you to choose a certain number in order to solve.

Example 1:

If t = 4w and w = 3v, what is the value of t in terms of v?

a) v
b) 4v
c) 12v
d) 20v
e) 43v

For this problem you want to identify what you are solving for. In this case we are looking for the value of t. Do NOT substitute in a value for t. Instead let's substitute for only one variable and since we are looking for t in terms of v, let's choose a value for v. We can choose ANY value of v, however we cannot choose a value for w as well. The variable w will be forced to be a certain number based on our choice for v. Let's say v = 2. If v = 2 and w = 3v then w = 3(2) = 6. If w = 6 and t = 4w then t = 4(6) = 24. Therefore when v =2, t = 24. Now look at your answer choices. Since you were looking for t and t = 24 that is what we are looking for. Now we know v = 2 so substitute v=2 into your answer choices to see which answer yields 24.

a) v = 2
b) 4v = 4(2) = 8
c) 12v = 12(2) = 24
d) 20v = 20(2) = 40
e) 43v = 43(2) = 86

Sometimes a question will specifically list condition on a variable in the problem. Let's take a look at this type of problem.

Example 2:
If $x < 0$, which of the following must be true?

a) $x - x < 0$
b) $x^2 < 0$
c) $2x > 0$
d) $-x > 0$
e) $-x^2 > 0$

This question states that $x < 0$. Therefore, when you choose a number, you must choose a number for x that is less than 0. Let's choose $x = -2$. Now, let's use our answer choices to determine which answer works.

a) $x - x < 0$ would give us $(-2) - (-2) = 0$ and we know 0 is no less than 0 so this is not the answer
b) $x^2 < 0$ would give us $(-2)^2 = 4$ and we know that 4 is not less than 0
c) $2x > 0$ would give us $2(-2) = -4$ and we know that -4 is not greater than 0
d) $-x > 0$ would give us $-(-2) = 2$ and we know 2 is greater than 0 so this is the answer
e) $-x^2 > 0$ would give us $-(-2)^2 = -4$ and we know this is not greater than 0

Multiple Variables to Substitute

Some questions on the SAT will have multiple variables for you to substitute values. You will approach them using the same strategy. First check to see if there are any restrictions on your variables and then substitute.

Example 3:

If a and b are positive integers, and $a + b = 8$, then what is the value of $16 - 2b$?

a) 0
b) 1
c) a
d) 2a
e) 2b

In this problem we have two restrictions. The first is that a and b are positive numbers. The second is that $a + b = 8$. Therefore, we need to choose two positive numbers that add together to 8. Let's let $a = 4$ and $b = 4$ since $4+4 = 8$. We are looking for the value of $16 - 2b = 16 - 2(4) = 16-8 = 8$. Therefore, we need to see which answer gives us 8. Let's look at our answer choices.

a) 0 This is not the answer
b) 1 This is not the answer
c) $a = 4$ which is not the answer
d) $2a = 2(4) = 8$ This may be the answer
e) $2b = 2(4) = 8$ This may be the answer as well

For this problem we have two answers that may potentially work. I mentioned earlier that this may happen. In this case we need to choose two new values for a and b. Let's try a = 5 and b = 3 because 5 + 3 = 8 so we know these are good values to choose. You can choose any values that add to 8 and are positive. Therefore 16 – 2b = 16 – 2(3) = 16 – 6 = 10. Now let's look at our answer choices again. We know that choices a,b, and c are not the answer so let's check between d and e.

d) 2a = 2(5) = 10
e) 2b = 2(3) = 6

Therefore, we know the answer would be choice "d".

Questions with No Restrictions

These questions will have no restrictions on any variables in the problem. For these questions you are allowed to choose any variables to substitute in for the given variable.

Example 4:

Woodrow High School had a running competition at school. Carl ran *m* miles. Jamie ran twice as many miles as Carl, and Sam ran 5 miles fewer than Jamie. In terms of *m,* how many miles did Sam run?

a) $2m + 5$
b) $2m - 5$
c) $\frac{m}{2} + 5$
d) $\frac{2m}{5}$
e) $\frac{2m+5}{2}$

For this question there are no restrictions on *m*, therefore we can choose any value for m. Identify what you are trying to solve for, in this case we are looking for how many miles Sam ran. Let's say m = 5. If m = 5, then Carl ran 5 miles. Since Jamie ran twice as many miles as Carl, then Jamie ran 10 miles. Sam ran 5 miles fewer than Jamie so Sam ran 10-5 = 5 miles. This is what we were looking for so when m = 5 we are looking for which answer gives us 5.

a) $2m + 5 = 2(5) + 5 = 15$
b) $2m - 5 = 2(5) - 5 = 5$
c) $\frac{m}{2} + 5 = \frac{5}{2} + 5 = \frac{15}{2}$
d) $\frac{2m}{5} = \frac{2(5)}{5} = 2$
e) $\frac{2m+5}{2} = \frac{2(5)+5}{2} = \frac{15}{2}$

Therefore, the answer would be "b" since choice b yields the answer 5.

Let's take a look at another example.

Example 5:

6-2n, 6-n, 6, 6+n, 6 + 2n

What is the average (arithmetic mean) of the five quantities listed above?

a) 2
b) 3
c) 6
d) $4n + 6$
e) $6 + \frac{n}{4}$

This question has no restrictions on n, so you can choose any value. Let's say n = 3. If n = 3 then our five numbers would be 6-2(3), 6-(3), 6, 6+(3), 6 + 2(3) or 0, 3, 6, 9, 12. Since we are looking for the average of these numbers we need to find the average of 1,2,6,4, and 5. The average is the sum of all the numbers divided by the total amount. Therefore, $\frac{0+3+6+9+12}{5} = \frac{30}{5} = 6$. So the answer is "c".

Percent Questions Using the Substitution Method

Percents show up a lot on the SAT. It is important to make sure you are able to figure out these types of questions the easiest way as possible. The easiest percents to work with are 100% and 50%. Therefore if you have a chance to substitute in a percent, you will want to choose one of these numbers.

Example 6:

A new car costs $20,000. If you finance the car to pay p percent each year until the car is paid off, how much are you paying each year in terms of p?

a) $20p$
b) $200p$
c) $\frac{20000}{p}$
d) $\frac{200p}{100}$
e) $40p + 200$

Since p is the percent, let's choose p = 50. If p=50, then you are paying 50% of $20,000 which is $10,000. This is what we are looking for so let's look at our answer choices.

a) $20p = 20(50) = 1000$
b) $200p = 200(50) = 10{,}000$
c) $\frac{20{,}000}{p} = \frac{20{,}000}{50} = 400$
d) $\frac{200p}{100} = \frac{200(50)}{100} = 100$
e) $40p + 200 = 40(50) + 200 = 2{,}200$

Therefore the answer would be choice "b".

Substitution SAT Examples (NO CALCULATOR)

Example 1:

The formula below is used to compute, P the estimated price of apples, where L is the lowest possible price of apples, M is the maximum possible price of apples, and A is the average price of apples.

$$P = \frac{L + 4A + M}{5}$$

Which of the following correctly gives A in terms of P, L, and M?

A) $A = \frac{5P-L-M}{4}$
B) $A = \frac{L+4P+M}{5}$
C) $A = 5P - L - M$
D) $A = 5P - 4L - 4M$

Example 2:

If $\frac{3c}{d} = \frac{1}{9}$, what is the value of $\frac{d}{c}$?

A) $\frac{1}{27}$
B) $\frac{1}{9}$
C) 9
D) 27

Example 3:

The width of a rectangular garden is w feet. The length of the garden is 5 feet more than the width. Which of the following expresses the perimeter, in feet, of the garden in terms of w?

A) $2w + 20$
B) $4w + 5$
C) $4w + 10$
D) $4w + 20$

Example 4:

$$x^2 - 8x + 4$$

Which of the following is equivalent to the expression above?

A) $(x-4)^2 - 12$
B) $(x-4)^2 + 8$
C) $(x-2)^2 - 8$
D) $(x-2)^2 + 12$

Example 5:

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

Which of the following expressions is equivalent to the one above, where $x \neq 2$?

A) $\frac{8}{x-2}$
B) $\frac{5}{x-2}$
C) $\frac{10}{2(x-2)}$
D) $\frac{16}{2x-2}$

Example 6:

$$\frac{x^2 + 4x - 6}{x - 2}$$

Which of the following expressions is equivalent to the one above?

A) $x - 2 + \frac{4}{x-2}$
B) $x - 2 + \frac{15}{x-2}$
C) $x + 6 + \frac{10}{x-2}$
D) $x + 6 + \frac{6}{x-2}$

Substitution SAT Examples (CALCULATOR ALLOWED)

Example 7:

If $w^{-2} = y$ where w is an integer, what is w in terms of y ?

A) $\frac{1}{y^2}$
B) $-y^2$
C) $\pm\sqrt{y}$
D) $\pm\sqrt{\frac{1}{y}}$

Example 8:

$$V = 32{,}000(.92)^t$$

The equation above models the value, V, of a car t years after it is purchased. Of the following, which equation models the value of the car m months after it is purchased?

A) $V = 32{,}000(.92)^{12m}$
B) $V = 32{,}000(.92)^{\frac{m}{12}}$
C) $V = 32{,}000(.993)^{12m}$
D) $V = 32{,}000(.993)^{\frac{m}{12}}$

Example 9:

If x is the average (arithmetic mean) of n and 8, y is the average of $3n$ and 11, and z is the average of $2n$ and 5, what is the average of x, y, and z in terms of n ?

A) $n + 3$
B) $n + 4$
C) $2n + 8$
D) $3n + 6$

Example 10:

If $3\sqrt{3x} = a$, what is $3x$ in terms of a?

A) $\frac{a}{3}$
B) $\frac{a^2}{3}$
C) $\frac{a^2}{9}$
D) $9a^2$

Example 11:

A truck that starts from rest, travels f feet in t seconds, where $f = 5t\sqrt{t}$. Which of the following gives the average speed of the car, in feet per second, over the first t seconds after it starts?

A) $t\sqrt{t}$
B) $5\sqrt{t}$
C) $\frac{5}{\sqrt{t}}$
D) $5t$

Example 12:

Jerome bought a new pair of kicks that were 30% off the original price. He paid the cashier p dollars which included a 10% sales tax on the discounted price. What was the original price of the kicks, in terms of p ?

A) $(.30)(.10)p$
B) $(.70)(1.10)p$
C) $\frac{p}{(.30)(1.10)}$
D) $\frac{p}{(.70)(1.10)}$

Backsolving Method

The idea behind the backsolving method on the SAT or ACT is to use your answer choices to solve the problem. This strategy can be particularly useful as it can help you to avoid using complicated algebra on certain problems and can also provide you with a good starting point if you do not know how to approach a question.

Keys to the backsolving method

1. Identify the question
2. Look at your answer choices, these are the possible answers to that question
3. Start with choice "c" on the SAT or the equivalent choice on the ACT.
4. Re-read the question using your selected answer
5. Figure out if your answer works

Let's take a look at some examples and how to approach them.

Example 1:
If $x^2 + 2^x = 57$, what is the value of x?

a) 4
b) 5
c) 6
d) 7
e) 8

Let's start by identifying the question, "What is the value of x?" Here we have five possible choices for the value of x. Instead of trying to solve this problem algebraically, let's use our answers to help. Let's start with choice "c" and assume that x = 6. All we need to do now is check to see if our answer works.

$$x^2 + 2^x = 57$$
$$(6)^2 + 2^6 = 57?$$
$$36 + 64 = 57?$$
$$100 = 57?$$

We can clearly see that this is not the correct answer. We can also see that our value of x was too high and needs to be lowered. This is why it is important to start with choice "c". Now we know the answer cannot be choices "c", "d", or "e". Let's try choice "b"

$$(5)^2 + 2^5 = 57?$$
$$25 + 32 = 57?$$
$$57 = 57$$

Yes! 57=57 so choice "b" is the correct answer!

Example 2:
Emily is counting her money. She has a stack of $5 bills and $20 bills. She has a total of fifteen bills. If she has a total of $195, how many $20 bills does she have?

a) Two
b) Four
c) Six
d) Eight
e) Ten

Let's start by identifying the question: "How many $20 bills does she have?" Let's start with choice "c". Assume she has six $20 bills.

Let's pull out some other information relevant to the problem: She has fifteen bills. Therefore if she has six $20 bills, she must have nine $5 bills (6+9 = 15). Next, let's calculate how much money she has under this scenario, 6($20) + 9($5) = $120 + $45 = $165. Is that what we were looking for? No, we need $195. You can see this is not enough money, therefore we need to get more money so we need to increase the number of $20 bills. Based on this logic we can eliminate choices "a", "b", and "c".

Let's try choice "d". Let's assume she had eight $20 bills. Then she must have seven $5 bills. Now let's calculate the total amount under this scenario. 8($20) + 7($5) = $160 + $35 = $195. This is what we were looking for! This is the correct answer.

Example 3:
Jayden is throwing a party and decides he needs to buy two types of snacks, chips and pretzels. He decided to buy 10 bags of snacks. A bag of pretzels cost $4 and a bag of chips cost $3.50. Jayden spent a total of $38.00. How many bags of chips did he buy?

a) 1
b) 2
c) 3
d) 4
e) 5

Let's start by identifying the question: "How many bags of chips did he buy?" This means he either bought 1, 2, 3, 4, or 5 bags of chips. We know we should always start with choice "c". Let's assume he bought 3 bags of chips.

Let's also pull out some key information from the problem:

1) He bought 10 bags of snacks, so if he bought 3 bags of chips then he bought 7 bags of pretzels.
2) A bag of chips cost $3.50 each so that means he spent 3($3.50) = $10.50
   A bag of pretzels cost $4.00 each so that means he spent 7($4) = $28.00
3) So under this scenario, he would have spend $10.50 + $28.00 = $38.50

That price is too high! We need to get that price lower. Notice in this case in order to get the price lower we want to have more of the cheaper item and less of the higher priced item. Therefore, we want to increase the number of bags of chips and lower the number of bags of pretzels. Once we have come to this realization, we can eliminate choices "a", "b", and "c". It must either be choice "d" or "e".

Let's try choice "d" next. Let's assume he bought 4 bags of chips, then he must have bought 6 bags of pretzels. Under this scenario he spent 4($3.5) = $14 on chips and 6($4) = $24. In total he spent, $14 + $24 = $38. This is the answer we were looking for and therefore have solved the problem.

Example 4

$$g(t) = t^2 - 32t + k$$

For two months, the number of dogs at the park could be determined by using the function g above. In the function, k is a constant and $g(t)$ represents the number of dogs in the park on day number t for $0 \leq t \leq 62$. On what day number was the number of dogs at the park the same as it was on day number 8?

a) 6
b) 12
c) 24
d) 48
e) 62

Let's start by identifying our question: "On what day number was the number of dogs at the park the same as it was on day number 8?" Well, a good first step would be to figure out how many dogs there were on day number 8. Let's substitute 8 into our function to determine the correct answer.

$$\begin{aligned} g(t) &= t^2 - 32t + k \\ g(8) &= 8^2 - 32(8) + k \\ g(8) &= 64 - 256 + k \\ g(8) &= -192 + k \end{aligned}$$

This may seem like a weird answer, but that is okay. We just need to make sure our answer matches it. Let's try choice "c". Let's see how many dogs there were on day number 24.

$$\begin{aligned} g(t) &= t^2 - 32t + k \\ g(24) &= 24^2 - 32(24) + k \\ g(24) &= 576 - 768 + k \\ g(24) &= -192 + k \end{aligned}$$

As you can see, our answers match and therefore we have found the correct answer!

Backsolving SAT Examples (NO CALCULATOR)

Example 1:

$$\sqrt{x+n} = x - 3$$

If $n = 17$, what is the solution set to the equation above?

A) $\{-1,8\}$
B) $\{-1,-8\}$
C) $\{-1\}$
D) $\{8\}$

Example 2:

Tickets to a Broadway show cost \$30 for early birds and \$50 if bought at the door. If a total of 40 tickets were sold, and the total ticket sales were \$1800, how many tickets were bought at the door?

A) 10
B) 20
C) 30
D) 40

Example 3:

$$x = 3y - 1$$

$$2y = x - 5$$

Which ordered pair (x, y) satisfies the system of equations shown above?

A) (2,0)
B) (8,3)
C) (14,5)
D) (17,6)

Example 4:

What are the solutions to the equation $3x^2 - 21x + 30 = 0$?

A) $x = -2$ and $x = -5$
B) $x = -1$ and $x = -10$
C) $x = 2$ and $x = 5$
D) $x = 1$ and $x = 10$

Example 5:

The expression $\frac{1}{4}x^2 - 2$ can be rewritten as $\frac{1}{4}(x - k)(x + k)$, where k is a positive constant. What is the value of k?

A) 2
B) 8
C) $\sqrt{2}$
D) $\sqrt{8}$

Example 6:

$$\frac{x + 1}{y} = 7$$

$$4(y + 2) = x$$

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

A) 3
B) 4
C) 20
D) 24

Backsolving SAT Examples (CALCULATOR ALLOWED)

Example 7:

If $\frac{2}{3}x = \frac{5}{2}$, what is the value of x?

A) $\frac{10}{6}$
B) $\frac{15}{4}$
C) $\frac{7}{5}$
D) 3

Example 8:

In a hockey game, Josh starts with p points. For each target that he fails to hit, he loses 3 points. If Josh gains no additional points and he fails to hit 50 targets, he will finish with a score of 350 points, what is the value of p?

A) 150
B) 400
C) 450
D) 500

Example 9:

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

In the equation above, which of the following is a possible value for $x + 4$?

A) $\sqrt{3}$
B) $\sqrt{3} + 4$
C) 1
D) 2

Example 10:

Which of the following is a value of x for which the expression $\frac{-3}{x^2-13x+30}$ is undefined?

A) -10
B) -2
C) 3
D) 15

Example 11:

If $2p - 4 \geq -2$, what is the least possible value of $2p + 4$?

A) 1
B) 2
C) 5
D) 6

Example 12:

In the equation $(ax - 9)^2 = 1$, a is a constant. If $x = -4$ is one solution to the given equation, what is a possible value of a?

A) -8
B) -4
C) -2
D) 0

Stuck on a Question

If you get stuck on a question, you should ask yourself the following questions.

1. Can you use your answer choices to help solve the question?
   This is called backsolving. Identify the question and realize the answer choices are the possible answers to that question.

2. Can you substitute in values for unknown parts of the questions?
   For example, if there are variables, can you put in real numbers for variables? If you can, answer the question using your numbers and match it with the correct answer.

3. Can you graph it?
   Some questions will provide you with an equation and the answer can simply be found by graphing the equation.

4. Can you draw a picture?
   If the question mentions a shape or polygon, sometimes the best way to approach this problem is by drawing a picture or diagram.

5. If there is a diagram, did you fill in all the information possible?
   Pictures are commonly given to you on the SAT, it is important to fill in all the information, whether that is filling in all the angles and sides. If you are still stuck, try extending lines or drawing in extra lines that are not already in your picture.

Additional Things to Remember:

6. $f(x) = y$
   Inside the parentheses is the x-value, while the function equals the y-value. If a question tells you $f(2) = 6$, this means when x=2, the y-value is 6.

7. "IS" means **EQUALS**, "OF" means **MULTIPLY**.
   Questions could read "If ¾ of x is 16, what is the value of x?" Translate this equation word for word and you will get the equation: $\frac{3}{4}x = 16$. Then simply solve for x.

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SAT® Practice Test #1

IMPORTANT REMINDERS

1

A No. 2 pencil is required for the test. Do not use a mechanical pencil or pen.

2

Sharing any questions with anyone is a violation of Test Security and Fairness policies and may result in your scores being canceled.

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Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

Turn to Section 3 of your answer sheet to answer the questions in this section.

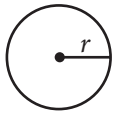
DIRECTIONS

For questions 1-15, solve each problem, choose the best answer from the choices provided, and fill in the corresponding circle on your answer sheet. **For questions 16-20**, solve the problem and enter your answer in the grid on the answer sheet. Please refer to the directions before question 16 on how to enter your answers in the grid. You may use any available space in your test booklet for scratch work.

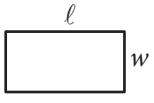
NOTES

1. The use of a calculator **is not permitted**.
2. All variables and expressions used represent real numbers unless otherwise indicated.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated, the domain of a given function f is the set of all real numbers x for which $f(x)$ is a real number.

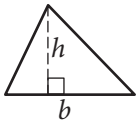
REFERENCE



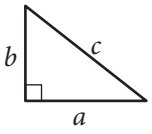
$A = \pi r^2$
$C = 2\pi r$



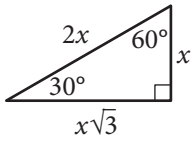
$A = \ell w$

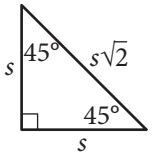


$A = \frac{1}{2}bh$

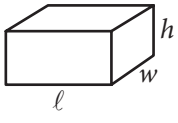


$c^2 = a^2 + b^2$

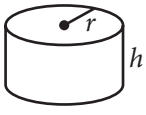




Special Right Triangles

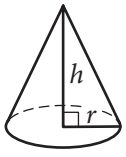


$V = \ell wh$

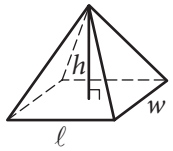


$V = \pi r^2 h$

$V = \frac{4}{3}\pi r^3$



$V = \frac{1}{3}\pi r^2 h$



$V = \frac{1}{3}\ell wh$

The number of degrees of arc in a circle is 360.
The number of radians of arc in a circle is 2π.
The sum of the measures in degrees of the angles of a triangle is 180.

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CONTINUE

1

If $\frac{x-1}{3} = k$ and $k = 3$, what is the value of x ?

A) 2

B) 4

C) 9

D) 10

2

For $i = \sqrt{-1}$, what is the sum $(7 + 3i) + (-8 + 9i)$?

A) $-1 + 12i$

B) $-1 - 6i$

C) $15 + 12i$

D) $15 - 6i$

3

On Saturday afternoon, Armand sent m text messages each hour for 5 hours, and Tyrone sent p text messages each hour for 4 hours. Which of the following represents the total number of messages sent by Armand and Tyrone on Saturday afternoon?

A) $9mp$

B) $20mp$

C) $5m + 4p$

D) $4m + 5p$

4

Kathy is a repair technician for a phone company. Each week, she receives a batch of phones that need repairs. The number of phones that she has left to fix at the end of each day can be estimated with the equation $P = 108 - 23d$, where P is the number of phones left and d is the number of days she has worked that week. What is the meaning of the value 108 in this equation?

A) Kathy will complete the repairs within 108 days.

B) Kathy starts each week with 108 phones to fix.

C) Kathy repairs phones at a rate of 108 per hour.

D) Kathy repairs phones at a rate of 108 per day.

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CONTINUE

5

$$(x^2y - 3y^2 + 5xy^2) - (-x^2y + 3xy^2 - 3y^2)$$

Which of the following is equivalent to the expression above?

A) $4x^2y^2$

B) $8xy^2 - 6y^2$

C) $2x^2y + 2xy^2$

D) $2x^2y + 8xy^2 - 6y^2$

6

$$h = 3a + 28.6$$

A pediatrician uses the model above to estimate the height h of a boy, in inches, in terms of the boy's age a, in years, between the ages of 2 and 5. Based on the model, what is the estimated increase, in inches, of a boy's height each year?

A) 3

B) 5.7

C) 9.5

D) 14.3

7

$$m = \frac{\left(\frac{r}{1{,}200}\right)\left(1 + \frac{r}{1{,}200}\right)^N}{\left(1 + \frac{r}{1{,}200}\right)^N - 1} P$$

The formula above gives the monthly payment m needed to pay off a loan of P dollars at r percent annual interest over N months. Which of the following gives P in terms of m, r, and N ?

A) $P = \dfrac{\left(\frac{r}{1{,}200}\right)\left(1 + \frac{r}{1{,}200}\right)^N}{\left(1 + \frac{r}{1{,}200}\right)^N - 1} m$

B) $P = \dfrac{\left(1 + \frac{r}{1{,}200}\right)^N - 1}{\left(\frac{r}{1{,}200}\right)\left(1 + \frac{r}{1{,}200}\right)^N} m$

C) $P = \left(\dfrac{r}{1{,}200}\right) m$

D) $P = \left(\dfrac{1{,}200}{r}\right) m$

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CONTINUE

8

If $\frac{a}{b} = 2$, what is the value of $\frac{4b}{a}$?

A) 0

B) 1

C) 2

D) 4

9

$$3x + 4y = -23$$
$$2y - x = -19$$

What is the solution (x, y) to the system of equations above?

A) $(-5, -2)$

B) $(3, -8)$

C) $(4, -6)$

D) $(9, -6)$

10

$$g(x) = ax^2 + 24$$

For the function g defined above, a is a constant and $g(4) = 8$. What is the value of $g(-4)$?

A) 8

B) 0

C) -1

D) -8

11

$$b = 2.35 + 0.25x$$
$$c = 1.75 + 0.40x$$

In the equations above, b and c represent the price per pound, in dollars, of beef and chicken, respectively, x weeks after July 1 during last summer. What was the price per pound of beef when it was equal to the price per pound of chicken?

A) \$2.60

B) \$2.85

C) \$2.95

D) \$3.35

12

A line in the xy-plane passes through the origin and has a slope of $\frac{1}{7}$. Which of the following points lies on the line?

A) $(0, 7)$

B) $(1, 7)$

C) $(7, 7)$

D) $(14, 2)$

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CONTINUE

13

If $x > 3$, which of the following is equivalent to $\dfrac{1}{\dfrac{1}{x+2}+\dfrac{1}{x+3}}$?

A) $\dfrac{2x+5}{x^2+5x+6}$

B) $\dfrac{x^2+5x+6}{2x+5}$

C) $2x+5$

D) x^2+5x+6

14

If $3x - y = 12$, what is the value of $\dfrac{8^x}{2^y}$?

A) 2^{12}

B) 4^4

C) 8^2

D) The value cannot be determined from the information given.

15

If $(ax+2)(bx+7) = 15x^2 + cx + 14$ for all values of x, and $a + b = 8$, what are the two possible values for c ?

A) 3 and 5

B) 6 and 35

C) 10 and 21

D) 31 and 41

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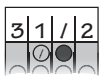
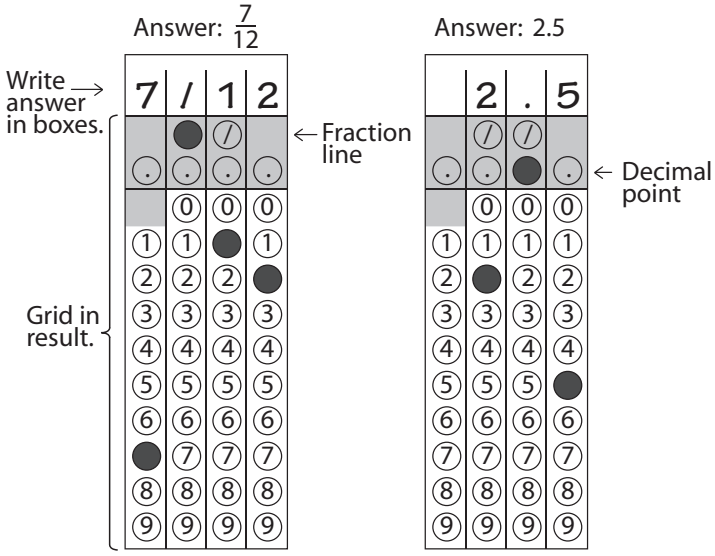
CONTINUE

DIRECTIONS

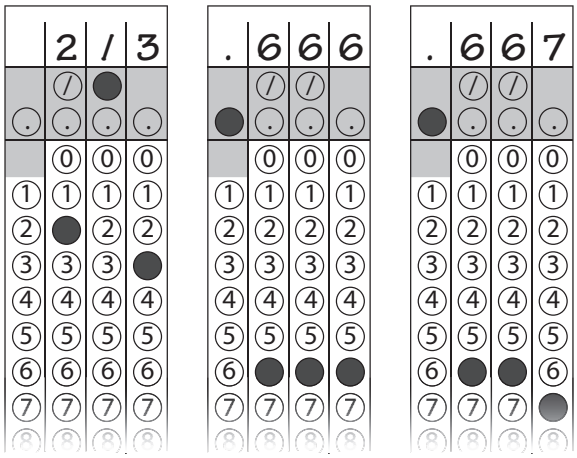
For questions 16–20, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.
4. Some problems may have more than one correct answer. In such cases, grid only one answer.
5. **Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or 7/2. (If 

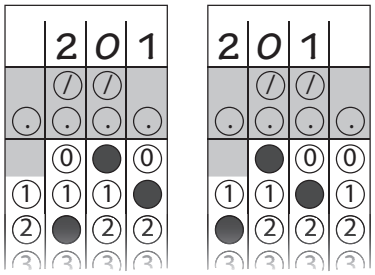
is entered into the grid, it will be interpreted as $\frac{31}{2}$, not $3\frac{1}{2}$.)
6. **Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.



Acceptable ways to grid $\frac{2}{3}$ are:



Answer: 201 – either position is correct



NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.

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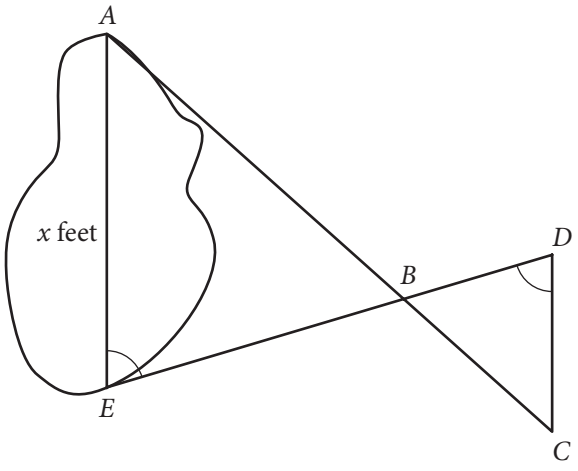
CONTINUE

16

If $t > 0$ and $t^2 - 4 = 0$, what is the value of t ?

17



A summer camp counselor wants to find a length, x, in feet, across a lake as represented in the sketch above. The lengths represented by AB, EB, BD, and CD on the sketch were determined to be 1800 feet, 1400 feet, 700 feet, and 800 feet, respectively. Segments AC and DE intersect at B, and $\angle AEB$ and $\angle CDB$ have the same measure. What is the value of x ?

18

$$x + y = -9$$
$$x + 2y = -25$$

According to the system of equations above, what is the value of x ?

19

In a right triangle, one angle measures $x°$, where $\sin x° = \frac{4}{5}$. What is $\cos(90° - x°)$?

20

If $a = 5\sqrt{2}$ and $2a = \sqrt{2x}$, what is the value of x ?

STOP

If you finish before time is called, you may check your work on this section only. Do not turn to any other section.

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No Test Material On This Page

Math Test – Calculator

55 MINUTES, 38 QUESTIONS

Turn to Section 4 of your answer sheet to answer the questions in this section.

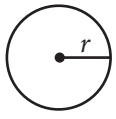
DIRECTIONS

For questions 1-30, solve each problem, choose the best answer from the choices provided, and fill in the corresponding circle on your answer sheet. **For questions 31-38**, solve the problem and enter your answer in the grid on the answer sheet. Please refer to the directions before question 31 on how to enter your answers in the grid. You may use any available space in your test booklet for scratch work.

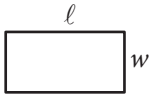
NOTES

1. The use of a calculator **is permitted**.
2. All variables and expressions used represent real numbers unless otherwise indicated.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated, the domain of a given function f is the set of all real numbers x for which $f(x)$ is a real number.

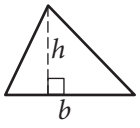
REFERENCE



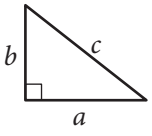
$A = \pi r^2$
$C = 2\pi r$



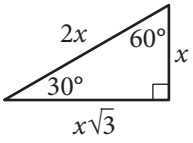
$A = \ell w$

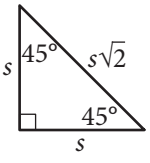


$A = \frac{1}{2}bh$

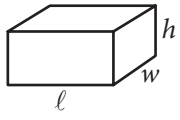


$c^2 = a^2 + b^2$

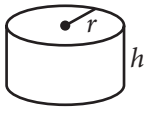




Special Right Triangles

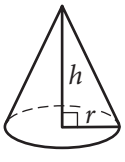


$V = \ell wh$

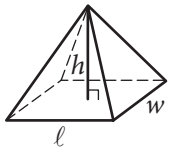


$V = \pi r^2 h$

$V = \frac{4}{3}\pi r^3$



$V = \frac{1}{3}\pi r^2 h$



$V = \frac{1}{3}\ell wh$

The number of degrees of arc in a circle is 360.
The number of radians of arc in a circle is 2π.
The sum of the measures in degrees of the angles of a triangle is 180.

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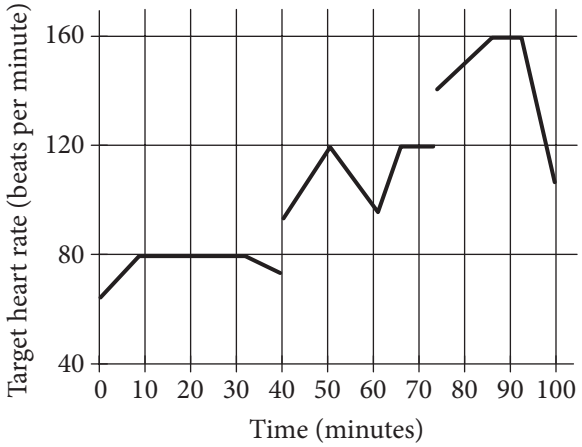
CONTINUE

1

John runs at different speeds as part of his training program. The graph shows his target heart rate at different times during his workout. On which interval is the target heart rate strictly increasing then strictly decreasing?



A) Between 0 and 30 minutes

B) Between 40 and 60 minutes

C) Between 50 and 65 minutes

D) Between 70 and 90 minutes

2

If $y = kx$, where k is a constant, and $y = 24$ when $x = 6$, what is the value of y when $x = 5$?

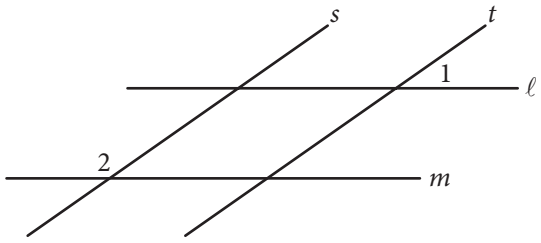
A) 6

B) 15

C) 20

D) 23

3



In the figure above, lines ℓ and m are parallel and lines s and t are parallel. If the measure of $\angle 1$ is 35°, what is the measure of $\angle 2$?

A) 35°

B) 55°

C) 70°

D) 145°

4

If $16 + 4x$ is 10 more than 14, what is the value of $8x$?

A) 2

B) 6

C) 16

D) 80

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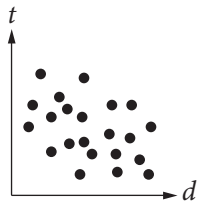
CONTINUE

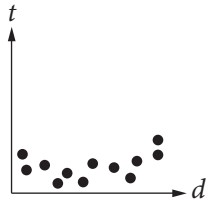
5

Which of the following graphs best shows a strong negative association between d and t ?

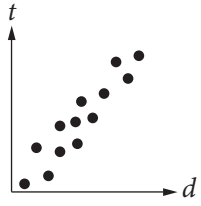
A)



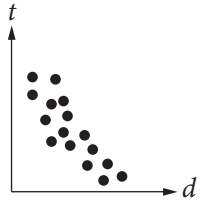
B)



C)



D)



6

1 decagram = 10 grams
1,000 milligrams = 1 gram

A hospital stores one type of medicine in 2-decagram containers. Based on the information given in the box above, how many 1-milligram doses are there in one 2-decagram container?

A) 0.002

B) 200

C) 2,000

D) 20,000

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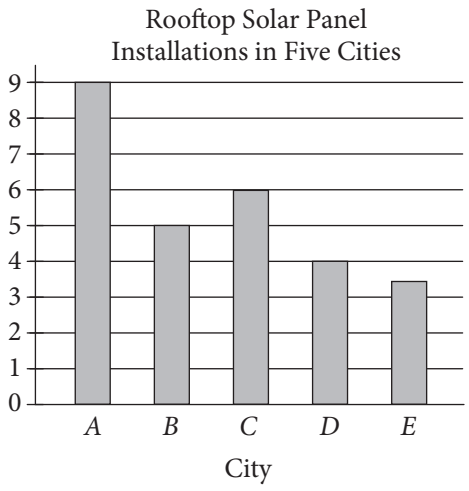
7



The number of rooftops with solar panel installations in 5 cities is shown in the graph above. If the total number of installations is 27,500, what is an appropriate label for the vertical axis of the graph?

A) Number of installations (in tens)

B) Number of installations (in hundreds)

C) Number of installations (in thousands)

D) Number of installations (in tens of thousands)

8

For what value of n is $|n - 1| + 1$ equal to 0 ?

A) 0

B) 1

C) 2

D) There is no such value of n.

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CONTINUE

Questions 9 and 10 refer to the following information.

$$a = 1{,}052 + 1.08t$$

The speed of a sound wave in air depends on the air temperature. The formula above shows the relationship between a, the speed of a sound wave, in feet per second, and t, the air temperature, in degrees Fahrenheit (°F).

9

Which of the following expresses the air temperature in terms of the speed of a sound wave?

A) $t = \dfrac{a - 1{,}052}{1.08}$

B) $t = \dfrac{a + 1{,}052}{1.08}$

C) $t = \dfrac{1{,}052 - a}{1.08}$

D) $t = \dfrac{1.08}{a + 1{,}052}$

10

At which of the following air temperatures will the speed of a sound wave be closest to 1,000 feet per second?

A) −46°F

B) −48°F

C) −49°F

D) −50°F

11

Which of the following numbers is NOT a solution of the inequality $3x - 5 \geq 4x - 3$?

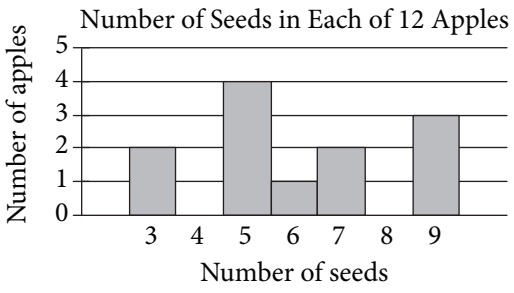
A) −1

B) −2

C) −3

D) −5

12



Based on the histogram above, of the following, which is closest to the average (arithmetic mean) number of seeds per apple?

A) 4

B) 5

C) 6

D) 7

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CONTINUE

13

		Course			
		Algebra I	Geometry	Algebra II	Total
Gender	Female	35	53	62	150
	Male	44	59	57	160
	Total	79	112	119	310

A group of tenth-grade students responded to a survey that asked which math course they were currently enrolled in. The survey data were broken down as shown in the table above. Which of the following categories accounts for approximately 19 percent of all the survey respondents?

A) Females taking Geometry

B) Females taking Algebra II

C) Males taking Geometry

D) Males taking Algebra I

14

Lengths of Fish (in inches)						
8	9	9	9	10	10	11
11	12	12	12	12	13	13
13	14	14	15	15	16	24

The table above lists the lengths, to the nearest inch, of a random sample of 21 brown bullhead fish. The outlier measurement of 24 inches is an error. Of the mean, median, and range of the values listed, which will change the most if the 24-inch measurement is removed from the data?

A) Mean

B) Median

C) Range

D) They will all change by the same amount.

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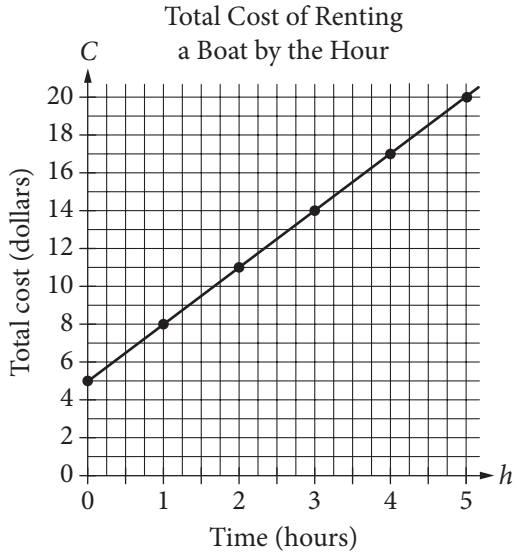
CONTINUE

Questions 15 and 16 refer to the following information.



The graph above displays the total cost C, in dollars, of renting a boat for h hours.

15

What does the C-intercept represent in the graph?

A) The initial cost of renting the boat

B) The total number of boats rented

C) The total number of hours the boat is rented

D) The increase in cost to rent the boat for each additional hour

16

Which of the following represents the relationship between h and C ?

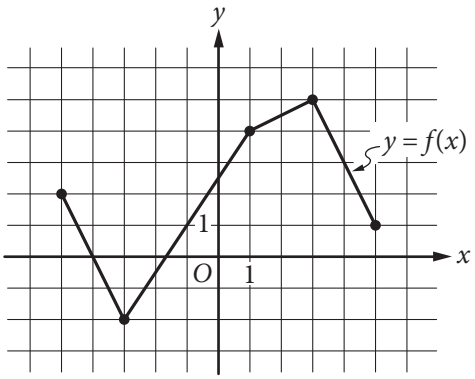
A) $C = 5h$

B) $C = \frac{3}{4}h + 5$

C) $C = 3h + 5$

D) $h = 3C$

17



The complete graph of the function f is shown in the xy-plane above. For what value of x is the value of $f(x)$ at its minimum?

A) -5

B) -3

C) -2

D) 3

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CONTINUE

18

$$y < -x + a$$
$$y > x + b$$

In the xy-plane, if $(0, 0)$ is a solution to the system of inequalities above, which of the following relationships between a and b must be true?

A) $a > b$

B) $b > a$

C) $|a| > |b|$

D) $a = -b$

19

A food truck sells salads for \$6.50 each and drinks for \$2.00 each. The food truck's revenue from selling a total of 209 salads and drinks in one day was \$836.50. How many salads were sold that day?

A) 77

B) 93

C) 99

D) 105

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CONTINUE

20

Alma bought a laptop computer at a store that gave a 20 percent discount off its original price. The total amount she paid to the cashier was p dollars, including an 8 percent sales tax on the discounted price. Which of the following represents the original price of the computer in terms of p ?

A) $0.88p$

B) $\frac{p}{0.88}$

C) $(0.8)(1.08)p$

D) $\frac{p}{(0.8)(1.08)}$

21

Dreams Recalled during One Week

	None	1 to 4	5 or more	Total
Group X	15	28	57	100
Group Y	21	11	68	100
Total	36	39	125	200

The data in the table above were produced by a sleep researcher studying the number of dreams people recall when asked to record their dreams for one week. Group X consisted of 100 people who observed early bedtimes, and Group Y consisted of 100 people who observed later bedtimes. If a person is chosen at random from those who recalled at least 1 dream, what is the probability that the person belonged to Group Y ?

A) $\frac{68}{100}$

B) $\frac{79}{100}$

C) $\frac{79}{164}$

D) $\frac{164}{200}$

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CONTINUE

Questions 22 and 23 refer to the following information.

Annual Budgets for Different Programs in Kansas, 2007 to 2010

Program	Year			
	2007	2008	2009	2010
Agriculture/natural resources	373,904	358,708	485,807	488,106
Education	2,164,607	2,413,984	2,274,514	3,008,036
General government	14,347,325	12,554,845	10,392,107	14,716,155
Highways and transportation	1,468,482	1,665,636	1,539,480	1,773,893
Human resources	4,051,050	4,099,067	4,618,444	5,921,379
Public safety	263,463	398,326	355,935	464,233

The table above lists the annual budget, in thousands of dollars, for each of six different state programs in Kansas from 2007 to 2010.

22

Which of the following best approximates the average rate of change in the annual budget for agriculture/natural resources in Kansas from 2008 to 2010 ?

A) $50,000,000 per year
B) $65,000,000 per year
C) $75,000,000 per year
D) $130,000,000 per year

23

Of the following, which program's ratio of its 2007 budget to its 2010 budget is closest to the human resources program's ratio of its 2007 budget to its 2010 budget?

A) Agriculture/natural resources
B) Education
C) Highways and transportation
D) Public safety

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CONTINUE

24

Which of the following is an equation of a circle in the xy-plane with center $(0, 4)$ and a radius with endpoint $\left(\frac{4}{3}, 5\right)$?

A) $x^2 + (y - 4)^2 = \frac{25}{9}$

B) $x^2 + (y + 4)^2 = \frac{25}{9}$

C) $x^2 + (y - 4)^2 = \frac{5}{3}$

D) $x^2 + (y + 4)^2 = \frac{3}{5}$

25

$$h = -4.9t^2 + 25t$$

The equation above expresses the approximate height h, in meters, of a ball t seconds after it is launched vertically upward from the ground with an initial velocity of 25 meters per second. After approximately how many seconds will the ball hit the ground?

A) 3.5

B) 4.0

C) 4.5

D) 5.0

26

Katarina is a botanist studying the production of pears by two types of pear trees. She noticed that Type A trees produced 20 percent more pears than Type B trees did. Based on Katarina's observation, if the Type A trees produced 144 pears, how many pears did the Type B trees produce?

A) 115

B) 120

C) 124

D) 173

27

A square field measures 10 meters by 10 meters. Ten students each mark off a randomly selected region of the field; each region is square and has side lengths of 1 meter, and no two regions overlap. The students count the earthworms contained in the soil to a depth of 5 centimeters beneath the ground's surface in each region. The results are shown in the table below.

Region	Number of earthworms	Region	Number of earthworms
A	107	F	141
B	147	G	150
C	146	H	154
D	135	I	176
E	149	J	166

Which of the following is a reasonable approximation of the number of earthworms to a depth of 5 centimeters beneath the ground's surface in the entire field?

A) 150

B) 1,500

C) 15,000

D) 150,000

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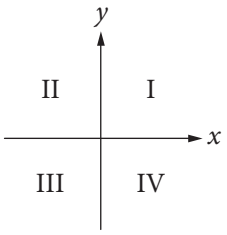
CONTINUE

28



If the system of inequalities $y \geq 2x + 1$ and $y > \frac{1}{2}x - 1$ is graphed in the xy-plane above, which quadrant contains no solutions to the system?

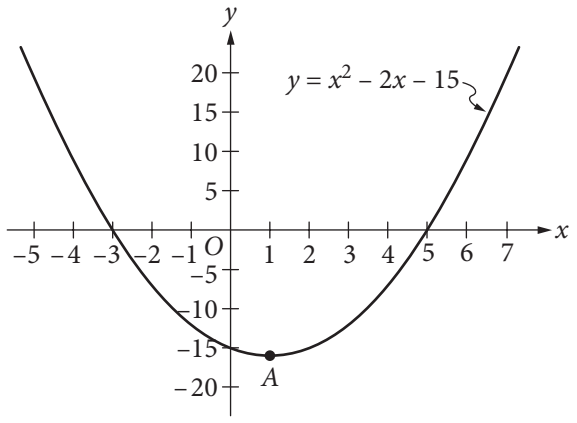
A) Quadrant II
B) Quadrant III
C) Quadrant IV
D) There are solutions in all four quadrants.

29

For a polynomial $p(x)$, the value of $p(3)$ is -2. Which of the following must be true about $p(x)$?

A) $x - 5$ is a factor of $p(x)$.
B) $x - 2$ is a factor of $p(x)$.
C) $x + 2$ is a factor of $p(x)$.
D) The remainder when $p(x)$ is divided by $x - 3$ is -2.

30



Which of the following is an equivalent form of the equation of the graph shown in the xy-plane above, from which the coordinates of vertex A can be identified as constants in the equation?

A) $y = (x + 3)(x - 5)$
B) $y = (x - 3)(x + 5)$
C) $y = x(x - 2) - 15$
D) $y = (x - 1)^2 - 16$

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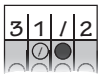
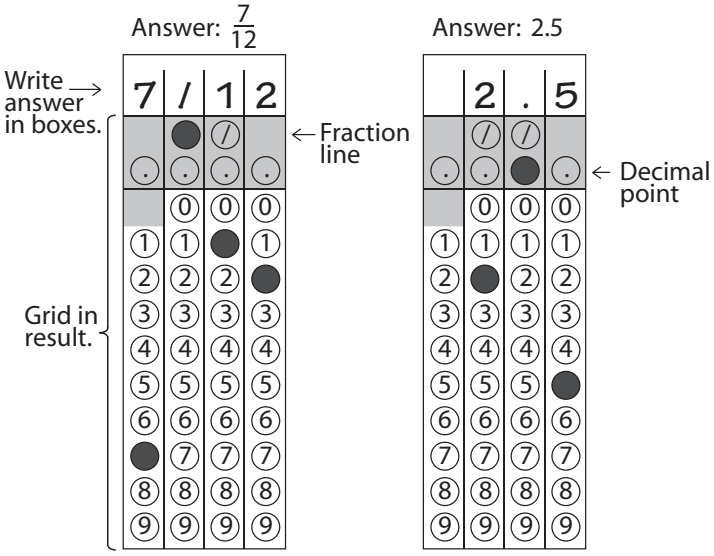
CONTINUE

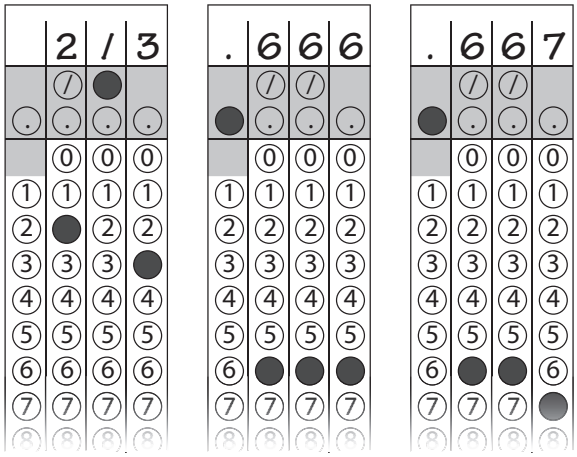
DIRECTIONS

For questions 31–38, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

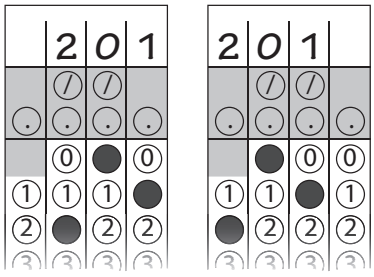
1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.
4. Some problems may have more than one correct answer. In such cases, grid only one answer.
5. **Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or 7/2. (If  is entered into the grid, it will be interpreted as $\frac{31}{2}$, not $3\frac{1}{2}$.)
6. **Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.



Acceptable ways to grid $\frac{2}{3}$ are:



Answer: 201 – either position is correct



NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.

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CONTINUE

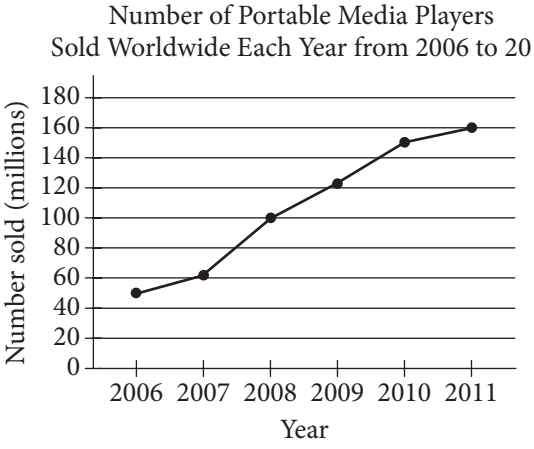
31

Wyatt can husk at least 12 dozen ears of corn per hour and at most 18 dozen ears of corn per hour. Based on this information, what is a possible amount of time, in hours, that it could take Wyatt to husk 72 dozen ears of corn?

32

The posted weight limit for a covered wooden bridge in Pennsylvania is 6000 pounds. A delivery truck that is carrying x identical boxes each weighing 14 pounds will pass over the bridge. If the combined weight of the empty delivery truck and its driver is 4500 pounds, what is the maximum possible value for x that will keep the combined weight of the truck, driver, and boxes below the bridge's posted weight limit?

33



According to the line graph above, the number of portable media players sold in 2008 is what fraction of the number sold in 2011 ?

34

A local television station sells time slots for programs in 30-minute intervals. If the station operates 24 hours per day, every day of the week, what is the total number of 30-minute time slots the station can sell for Tuesday and Wednesday?

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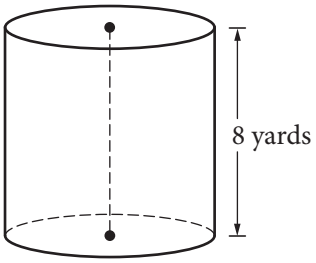
CONTINUE

35



A dairy farmer uses a storage silo that is in the shape of the right circular cylinder above. If the volume of the silo is 72π cubic yards, what is the diameter of the base of the cylinder, in yards?

36

$$h(x) = \frac{1}{(x-5)^2 + 4(x-5) + 4}$$

For what value of x is the function h above undefined?

Questions 37 and 38 refer to the following information.

Jessica opened a bank account that earns 2 percent interest compounded annually. Her initial deposit was \$100, and she uses the expression $\$100(x)^t$ to find the value of the account after t years.

37

What is the value of x in the expression?

38

Jessica's friend Tyshaun found an account that earns 2.5 percent interest compounded annually. Tyshaun made an initial deposit of \$100 into this account at the same time Jessica made a deposit of \$100 into her account. After 10 years, how much more money will Tyshaun's initial deposit have earned than Jessica's initial deposit? (Round your answer to the nearest cent and ignore the dollar sign when gridding your response.)

STOP

If you finish before time is called, you may check your work on this section only. Do not turn to any other section.

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CollegeBoard

SAT® Practice Test #2

IMPORTANT REMINDERS

1

A No. 2 pencil is required for the test. Do not use a mechanical pencil or pen.

2

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Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

Turn to Section 3 of your answer sheet to answer the questions in this section.

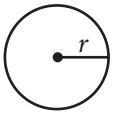
DIRECTIONS

For questions 1-15, solve each problem, choose the best answer from the choices provided, and fill in the corresponding circle on your answer sheet. **For questions 16-20**, solve the problem and enter your answer in the grid on the answer sheet. Please refer to the directions before question 16 on how to enter your answers in the grid. You may use any available space in your test booklet for scratch work.

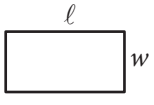
NOTES

1. The use of a calculator **is not permitted**.
2. All variables and expressions used represent real numbers unless otherwise indicated.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated, the domain of a given function f is the set of all real numbers x for which $f(x)$ is a real number.

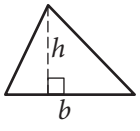
REFERENCE



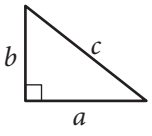
$A = \pi r^2$
$C = 2\pi r$



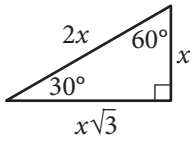
$A = \ell w$

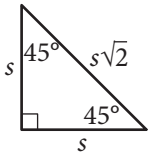


$A = \frac{1}{2}bh$

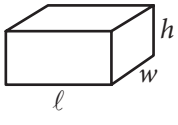


$c^2 = a^2 + b^2$

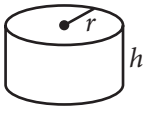




Special Right Triangles

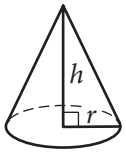


$V = \ell wh$

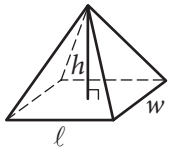


$V = \pi r^2 h$

$V = \frac{4}{3}\pi r^3$



$V = \frac{1}{3}\pi r^2 h$



$V = \frac{1}{3}\ell wh$

The number of degrees of arc in a circle is 360.
The number of radians of arc in a circle is 2π.
The sum of the measures in degrees of the angles of a triangle is 180.

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CONTINUE

1

If $5x + 6 = 10$, what is the value of $10x + 3$?

A) 4

B) 9

C) 11

D) 20

2

$$x + y = 0$$
$$3x - 2y = 10$$

Which of the following ordered pairs (x, y) satisfies the system of equations above?

A) $(3, -2)$

B) $(2, -2)$

C) $(-2, 2)$

D) $(-2, -2)$

3

A landscaping company estimates the price of a job, in dollars, using the expression $60 + 12nh$, where n is the number of landscapers who will be working and h is the total number of hours the job will take using n landscapers. Which of the following is the best interpretation of the number 12 in the expression?

A) The company charges $12 per hour for each landscaper.

B) A minimum of 12 landscapers will work on each job.

C) The price of every job increases by $12 every hour.

D) Each landscaper works 12 hours a day.

4

$$9a^4 + 12a^2b^2 + 4b^4$$

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

A) $(3a^2 + 2b^2)^2$

B) $(3a + 2b)^4$

C) $(9a^2 + 4b^2)^2$

D) $(9a + 4b)^4$

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CONTINUE

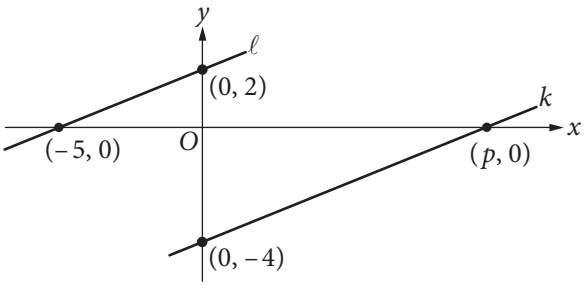
5

$$\sqrt{2k^2 + 17} - x = 0$$

If $k > 0$ and $x = 7$ in the equation above, what is the value of k ?

A) 2
B) 3
C) 4
D) 5

6



In the xy-plane above, line ℓ is parallel to line k. What is the value of p ?

A) 4
B) 5
C) 8
D) 10

7

If $\frac{x^{a^2}}{x^{b^2}} = x^{16}$, $x > 1$, and $a + b = 2$, what is the value of $a - b$?

A) 8
B) 14
C) 16
D) 18

8

$$nA = 360$$

The measure A, in degrees, of an exterior angle of a regular polygon is related to the number of sides, n, of the polygon by the formula above. If the measure of an exterior angle of a regular polygon is greater than 50°, what is the greatest number of sides it can have?

A) 5
B) 6
C) 7
D) 8

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CONTINUE

9

The graph of a line in the xy-plane has slope 2 and contains the point $(1, 8)$. The graph of a second line passes through the points $(1, 2)$ and $(2, 1)$. If the two lines intersect at the point (a, b), what is the value of $a + b$?

A) 4

B) 3

C) -1

D) -4

10

Which of the following equations has a graph in the xy-plane for which y is always greater than or equal to -1 ?

A) $y = |x| - 2$

B) $y = x^2 - 2$

C) $y = (x - 2)^2$

D) $y = x^3 - 2$

11

Which of the following complex numbers is equivalent to $\frac{3 - 5i}{8 + 2i}$? (Note: $i = \sqrt{-1}$)

A) $\frac{3}{8} - \frac{5i}{2}$

B) $\frac{3}{8} + \frac{5i}{2}$

C) $\frac{7}{34} - \frac{23i}{34}$

D) $\frac{7}{34} + \frac{23i}{34}$

12

$$R = \frac{F}{N + F}$$

A website uses the formula above to calculate a seller's rating, R, based on the number of favorable reviews, F, and unfavorable reviews, N. Which of the following expresses the number of favorable reviews in terms of the other variables?

A) $F = \frac{RN}{R - 1}$

B) $F = \frac{RN}{1 - R}$

C) $F = \frac{N}{1 - R}$

D) $F = \frac{N}{R - 1}$

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CONTINUE

13

What is the sum of all values of m that satisfy $2m^2 - 16m + 8 = 0$?

A) -8

B) $-4\sqrt{3}$

C) $4\sqrt{3}$

D) 8

14

A radioactive substance decays at an annual rate of 13 percent. If the initial amount of the substance is 325 grams, which of the following functions f models the remaining amount of the substance, in grams, t years later?

A) $f(t) = 325(0.87)^t$

B) $f(t) = 325(0.13)^t$

C) $f(t) = 0.87(325)^t$

D) $f(t) = 0.13(325)^t$

15

The expression $\frac{5x-2}{x+3}$ is equivalent to which of the following?

A) $\frac{5-2}{3}$

B) $5 - \frac{2}{3}$

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

D) $5 - \frac{17}{x+3}$

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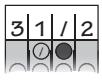
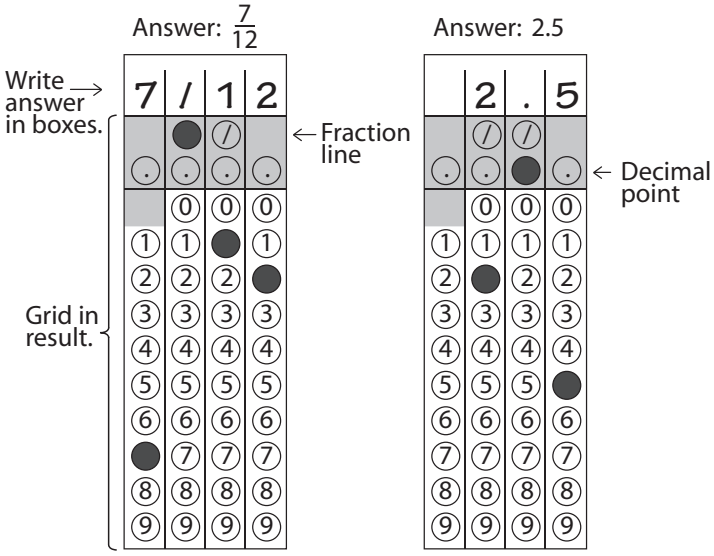
CONTINUE

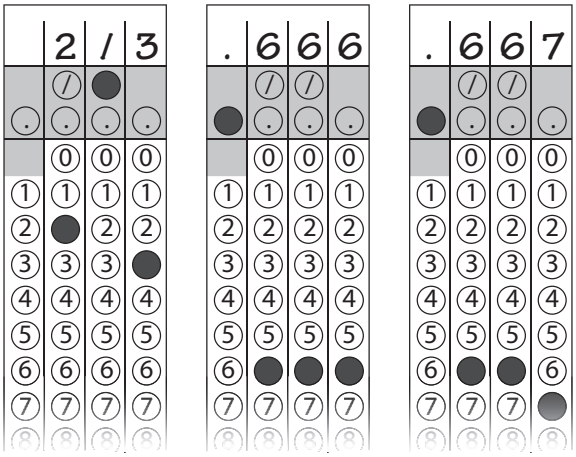
DIRECTIONS

For questions 16–20, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

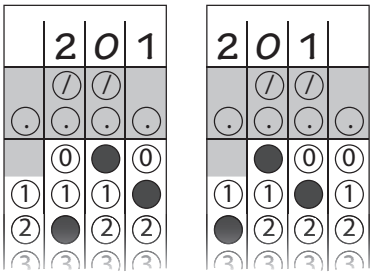
1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.
4. Some problems may have more than one correct answer. In such cases, grid only one answer.
5. **Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or 7/2. (If  is entered into the grid, it will be interpreted as $\frac{31}{2}$, not $3\frac{1}{2}$.)
6. **Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.



Acceptable ways to grid $\frac{2}{3}$ are:



Answer: 201 – either position is correct



NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.

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CONTINUE

16

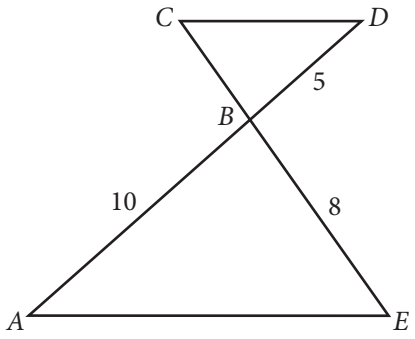
The sales manager of a company awarded a total of $3000 in bonuses to the most productive salespeople. The bonuses were awarded in amounts of $250 or $750. If at least one $250 bonus and at least one $750 bonus were awarded, what is one possible number of $250 bonuses awarded?

17

$$2x(3x + 5) + 3(3x + 5) = ax^2 + bx + c$$

In the equation above, a, b, and c are constants. If the equation is true for all values of x, what is the value of b ?

18



In the figure above, $\overline{AE} \parallel \overline{CD}$ and segment AD intersects segment CE at B. What is the length of segment CE ?

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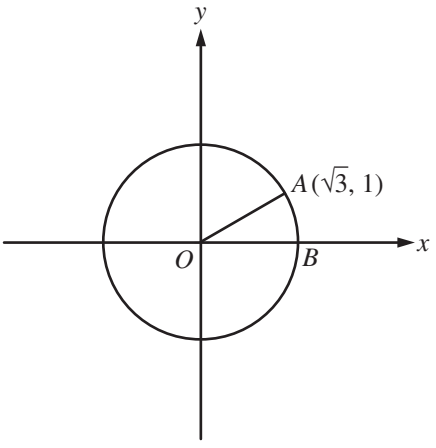
CONTINUE

19



In the xy-plane above, O is the center of the circle, and the measure of $\angle AOB$ is $\frac{\pi}{a}$ radians. What is the value of a ?

20

$$ax + by = 12$$
$$2x + 8y = 60$$

In the system of equations above, a and b are constants. If the system has infinitely many solutions, what is the value of $\frac{a}{b}$?

STOP

If you finish before time is called, you may check your work on this section only. Do not turn to any other section.

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Math Test – Calculator

55 MINUTES, 38 QUESTIONS

Turn to Section 4 of your answer sheet to answer the questions in this section.

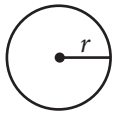
DIRECTIONS

For questions 1-30, solve each problem, choose the best answer from the choices provided, and fill in the corresponding circle on your answer sheet. **For questions 31-38**, solve the problem and enter your answer in the grid on the answer sheet. Please refer to the directions before question 31 on how to enter your answers in the grid. You may use any available space in your test booklet for scratch work.

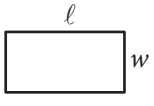
NOTES

1. The use of a calculator **is permitted**.
2. All variables and expressions used represent real numbers unless otherwise indicated.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated, the domain of a given function f is the set of all real numbers x for which $f(x)$ is a real number.

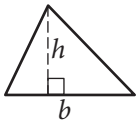
REFERENCE



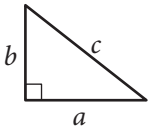
$A = \pi r^2$
$C = 2\pi r$



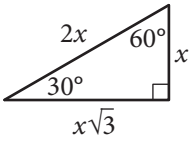
$A = \ell w$

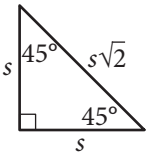


$A = \frac{1}{2}bh$

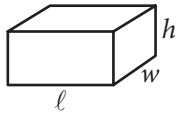


$c^2 = a^2 + b^2$

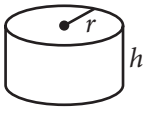




Special Right Triangles

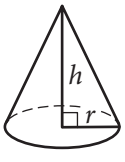


$V = \ell wh$

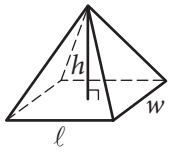


$V = \pi r^2 h$

$V = \frac{4}{3}\pi r^3$



$V = \frac{1}{3}\pi r^2 h$



$V = \frac{1}{3}\ell wh$

The number of degrees of arc in a circle is 360.
The number of radians of arc in a circle is 2π.
The sum of the measures in degrees of the angles of a triangle is 180.

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CONTINUE

1

A musician has a new song available for downloading or streaming. The musician earns \$0.09 each time the song is downloaded and \$0.002 each time the song is streamed. Which of the following expressions represents the amount, in dollars, that the musician earns if the song is downloaded d times and streamed s times?

A) $0.002d + 0.09s$

B) $0.002d - 0.09s$

C) $0.09d + 0.002s$

D) $0.09d - 0.002s$

2

A quality control manager at a factory selects 7 lightbulbs at random for inspection out of every 400 lightbulbs produced. At this rate, how many lightbulbs will be inspected if the factory produces 20,000 lightbulbs?

A) 300

B) 350

C) 400

D) 450

3

$$\ell = 24 + 3.5m$$

One end of a spring is attached to a ceiling. When an object of mass m kilograms is attached to the other end of the spring, the spring stretches to a length of ℓ centimeters as shown in the equation above. What is m when ℓ is 73 ?

A) 14

B) 27.7

C) 73

D) 279.5

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CONTINUE

Questions 4 and 5 refer to the following information.

The amount of money a performer earns is directly proportional to the number of people attending the performance. The performer earns $120 at a performance where 8 people attend.

4

How much money will the performer earn when 20 people attend a performance?

A) $960

B) $480

C) $300

D) $240

5

The performer uses 43% of the money earned to pay the costs involved in putting on each performance. The rest of the money earned is the performer's profit. What is the profit the performer makes at a performance where 8 people attend?

A) $51.60

B) $57.00

C) $68.40

D) $77.00

6

When 4 times the number x is added to 12, the result is 8. What number results when 2 times x is added to 7 ?

A) -1

B) 5

C) 8

D) 9

7

$$y = x^2 - 6x + 8$$

The equation above represents a parabola in the xy-plane. Which of the following equivalent forms of the equation displays the x-intercepts of the parabola as constants or coefficients?

A) $y - 8 = x^2 - 6x$

B) $y + 1 = (x - 3)^2$

C) $y = x(x - 6) + 8$

D) $y = (x - 2)(x - 4)$

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CONTINUE

8

In a video game, each player starts the game with k points and loses 2 points each time a task is not completed. If a player who gains no additional points and fails to complete 100 tasks has a score of 200 points, what is the value of k ?

A) 0

B) 150

C) 250

D) 400

9

A worker uses a forklift to move boxes that weigh either 40 pounds or 65 pounds each. Let x be the number of 40-pound boxes and y be the number of 65-pound boxes. The forklift can carry up to either 45 boxes or a weight of 2,400 pounds. Which of the following systems of inequalities represents this relationship?

A) $\begin{cases} 40x + 65y \le 2{,}400 \\ x + y \le 45 \end{cases}$

B) $\begin{cases} \frac{x}{40} + \frac{y}{65} \le 2{,}400 \\ x + y \le 45 \end{cases}$

C) $\begin{cases} 40x + 65y \le 45 \\ x + y \le 2{,}400 \end{cases}$

D) $\begin{cases} x + y \le 2{,}400 \\ 40x + 65y \le 2{,}400 \end{cases}$

10

A function f satisfies $f(2) = 3$ and $f(3) = 5$. A function g satisfies $g(3) = 2$ and $g(5) = 6$. What is the value of $f(g(3))$?

A) 2

B) 3

C) 5

D) 6

11

Number of hours Tony plans to read the novel per day	3
Number of parts in the novel	8
Number of chapters in the novel	239
Number of words Tony reads per minute	250
Number of pages in the novel	1,078
Number of words in the novel	349,168

Tony is planning to read a novel. The table above shows information about the novel, Tony's reading speed, and the amount of time he plans to spend reading the novel each day. If Tony reads at the rates given in the table, which of the following is closest to the number of days it would take Tony to read the entire novel?

A) 6

B) 8

C) 23

D) 324

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CONTINUE

12

On January 1, 2000, there were 175,000 tons of trash in a landfill that had a capacity of 325,000 tons. Each year since then, the amount of trash in the landfill increased by 7,500 tons. If y represents the time, in years, after January 1, 2000, which of the following inequalities describes the set of years where the landfill is at or above capacity?

A) $325{,}000 - 7{,}500 \leq y$

B) $325{,}000 \leq 7{,}500y$

C) $150{,}000 \geq 7{,}500y$

D) $175{,}000 + 7{,}500y \geq 325{,}000$

13

A researcher conducted a survey to determine whether people in a certain large town prefer watching sports on television to attending the sporting event. The researcher asked 117 people who visited a local restaurant on a Saturday, and 7 people refused to respond. Which of the following factors makes it least likely that a reliable conclusion can be drawn about the sports-watching preferences of all people in the town?

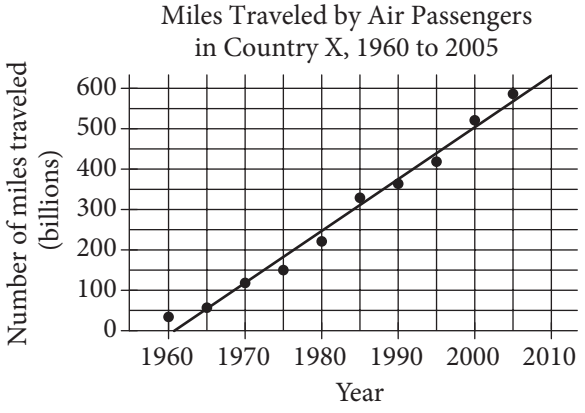
A) Sample size

B) Population size

C) The number of people who refused to respond

D) Where the survey was given

14



According to the line of best fit in the scatterplot above, which of the following best approximates the year in which the number of miles traveled by air passengers in Country X was estimated to be 550 billion?

A) 1997

B) 2000

C) 2003

D) 2008

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CONTINUE

15

The distance traveled by Earth in one orbit around the Sun is about 580,000,000 miles. Earth makes one complete orbit around the Sun in one year. Of the following, which is closest to the average speed of Earth, in miles per hour, as it orbits the Sun?

A) 66,000
B) 93,000
C) 210,000
D) 420,000

16

Results on the Bar Exam of Law School Graduates

	Passed bar exam	Did not pass bar exam
Took review course	18	82
Did not take review course	7	93

The table above summarizes the results of 200 law school graduates who took the bar exam. If one of the surveyed graduates who passed the bar exam is chosen at random for an interview, what is the probability that the person chosen did not take the review course?

A) $\frac{18}{25}$
B) $\frac{7}{25}$
C) $\frac{25}{200}$
D) $\frac{7}{200}$

17

The atomic weight of an unknown element, in atomic mass units (amu), is approximately 20% less than that of calcium. The atomic weight of calcium is 40 amu. Which of the following best approximates the atomic weight, in amu, of the unknown element?

A) 8
B) 20
C) 32
D) 48

18

A survey was taken of the value of homes in a county, and it was found that the mean home value was $165,000 and the median home value was $125,000. Which of the following situations could explain the difference between the mean and median home values in the county?

A) The homes have values that are close to each other.
B) There are a few homes that are valued much less than the rest.
C) There are a few homes that are valued much more than the rest.
D) Many of the homes have values between $125,000 and $165,000.

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CONTINUE

Questions 19 and 20 refer to the following information.

A sociologist chose 300 students at random from each of two schools and asked each student how many siblings he or she has. The results are shown in the table below.

Students' Sibling Survey

Number of siblings	Lincoln School	Washington School
0	120	140
1	80	110
2	60	30
3	30	10
4	10	10

There are a total of 2,400 students at Lincoln School and 3,300 students at Washington School.

19

What is the median number of siblings for all the students surveyed?

A) 0

B) 1

C) 2

D) 3

20

Based on the survey data, which of the following most accurately compares the expected total number of students with 4 siblings at the two schools?

A) The total number of students with 4 siblings is expected to be equal at the two schools.

B) The total number of students with 4 siblings at Lincoln School is expected to be 30 more than at Washington School.

C) The total number of students with 4 siblings at Washington School is expected to be 30 more than at Lincoln School.

D) The total number of students with 4 siblings at Washington School is expected to be 900 more than at Lincoln School.

21

A project manager estimates that a project will take x hours to complete, where $x > 100$. The goal is for the estimate to be within 10 hours of the time it will actually take to complete the project. If the manager meets the goal and it takes y hours to complete the project, which of the following inequalities represents the relationship between the estimated time and the actual completion time?

A) $x + y < 10$

B) $y > x + 10$

C) $y < x - 10$

D) $-10 < y - x < 10$

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CONTINUE

Questions 22 and 23 refer to the following information.

$$I = \frac{P}{4\pi r^2}$$

At a large distance r from a radio antenna, the intensity of the radio signal I is related to the power of the signal P by the formula above.

22

Which of the following expresses the square of the distance from the radio antenna in terms of the intensity of the radio signal and the power of the signal?

A) $r^2 = \frac{IP}{4\pi}$

B) $r^2 = \frac{P}{4\pi I}$

C) $r^2 = \frac{4\pi I}{P}$

D) $r^2 = \frac{I}{4\pi P}$

23

For the same signal emitted by a radio antenna, Observer A measures its intensity to be 16 times the intensity measured by Observer B. The distance of Observer A from the radio antenna is what fraction of the distance of Observer B from the radio antenna?

A) $\frac{1}{4}$

B) $\frac{1}{16}$

C) $\frac{1}{64}$

D) $\frac{1}{256}$

24

$$x^2 + y^2 + 4x - 2y = -1$$

The equation of a circle in the xy-plane is shown above. What is the radius of the circle?

A) 2

B) 3

C) 4

D) 9

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CONTINUE

25

The graph of the linear function f has intercepts at $(a, 0)$ and $(0, b)$ in the xy-plane. If $a + b = 0$ and $a \neq b$, which of the following is true about the slope of the graph of f ?

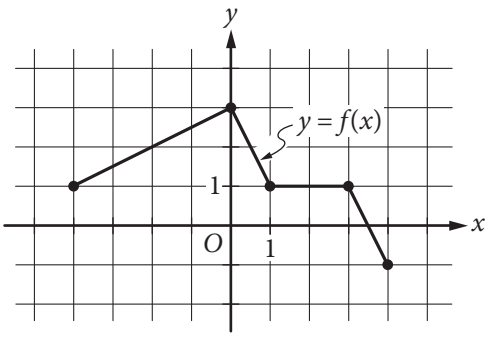
A) It is positive.

B) It is negative.

C) It equals zero.

D) It is undefined.

26



The complete graph of the function f is shown in the xy-plane above. Which of the following are equal to 1 ?

I. $f(-4)$

II. $f\left(\frac{3}{2}\right)$

III. $f(3)$

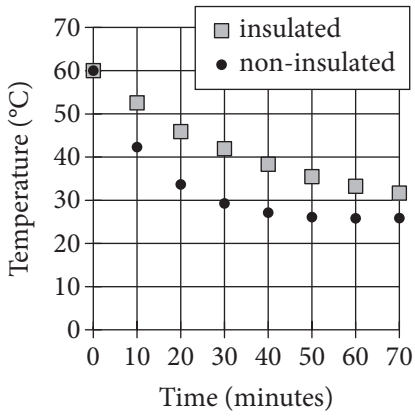
A) III only

B) I and III only

C) II and III only

D) I, II, and III

27



Two samples of water of equal mass are heated to 60 degrees Celsius (°C). One sample is poured into an insulated container, and the other sample is poured into a non-insulated container. The samples are then left for 70 minutes to cool in a room having a temperature of 25°C. The graph above shows the temperature of each sample at 10-minute intervals. Which of the following statements correctly compares the average rates at which the temperatures of the two samples change?

A) In every 10-minute interval, the magnitude of the rate of change of temperature of the insulated sample is greater than that of the non-insulated sample.

B) In every 10-minute interval, the magnitude of the rate of change of temperature of the non-insulated sample is greater than that of the insulated sample.

C) In the intervals from 0 to 10 minutes and from 10 to 20 minutes, the rates of change of temperature of the insulated sample are of greater magnitude, whereas in the intervals from 40 to 50 minutes and from 50 to 60 minutes, the rates of change of temperature of the non-insulated sample are of greater magnitude.

D) In the intervals from 0 to 10 minutes and from 10 to 20 minutes, the rates of change of temperature of the non-insulated sample are of greater magnitude, whereas in the intervals from 40 to 50 minutes and from 50 to 60 minutes, the rates of change of temperature of the insulated sample are of greater magnitude.

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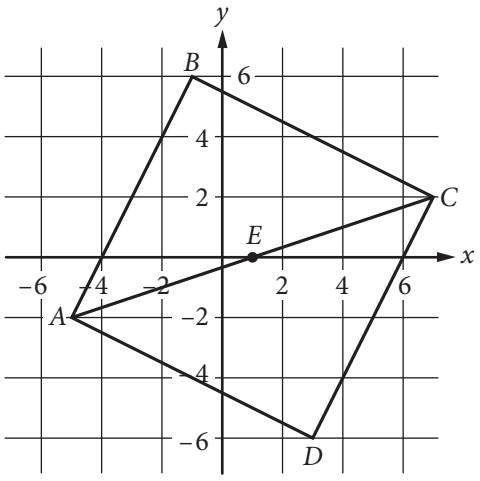
CONTINUE

28



In the xy-plane above, $ABCD$ is a square and point E is the center of the square. The coordinates of points C and E are $(7, 2)$ and $(1, 0)$, respectively. Which of the following is an equation of the line that passes through points B and D ?

A) $y = -3x - 1$

B) $y = -3(x - 1)$

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

D) $y = -\frac{1}{3}x - 1$

29

$$y = 3$$

$$y = ax^2 + b$$

In the system of equations above, a and b are constants. For which of the following values of a and b does the system of equations have exactly two real solutions?

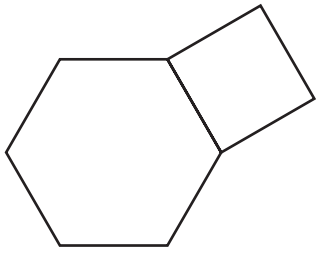
A) $a = -2,\ b = 2$

B) $a = -2,\ b = 4$

C) $a = 2,\ b = 4$

D) $a = 4,\ b = 3$

30



The figure above shows a regular hexagon with sides of length a and a square with sides of length a. If the area of the hexagon is $384\sqrt{3}$ square inches, what is the area, in square inches, of the square?

A) 256

B) 192

C) $64\sqrt{3}$

D) $16\sqrt{3}$

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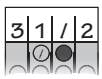
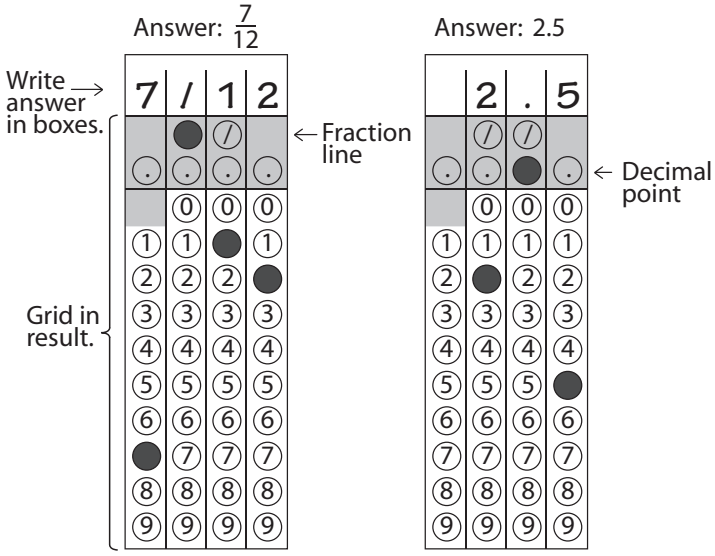
CONTINUE

DIRECTIONS

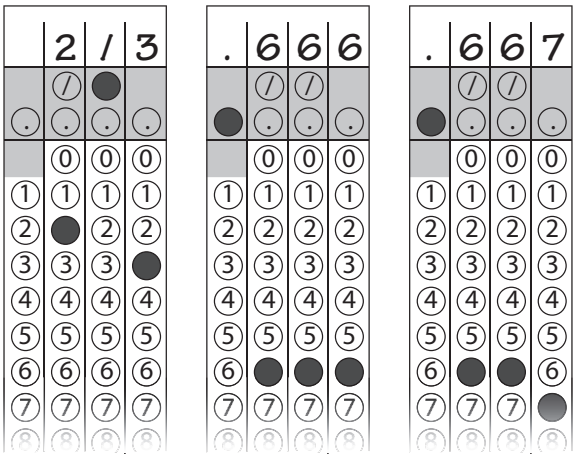
For questions 31-38, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.
4. Some problems may have more than one correct answer. In such cases, grid only one answer.
5. **Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or 7/2. (If 

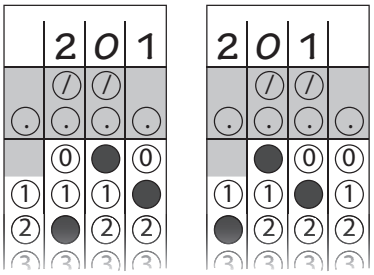
is entered into the grid, it will be interpreted as $\frac{31}{2}$, not $3\frac{1}{2}$.)
6. **Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.



Acceptable ways to grid $\frac{2}{3}$ are:



Answer: 201 – either position is correct



NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.

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CONTINUE

31

A coastal geologist estimates that a certain country's beaches are eroding at a rate of 1.5 feet per year. According to the geologist's estimate, how long will it take, in years, for the country's beaches to erode by 21 feet?

32

If h hours and 30 minutes is equal to 450 minutes, what is the value of h ?

33

In the xy-plane, the point $(3, 6)$ lies on the graph of the function $f(x) = 3x^2 - bx + 12$. What is the value of b ?

34

In one semester, Doug and Laura spent a combined 250 hours in the tutoring lab. If Doug spent 40 more hours in the lab than Laura did, how many hours did Laura spend in the lab?

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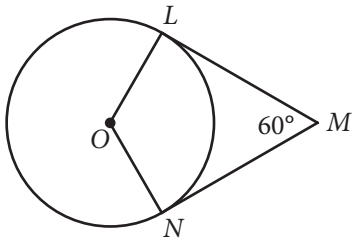
CONTINUE

35

$$a = 18t + 15$$

Jane made an initial deposit to a savings account. Each week thereafter she deposited a fixed amount to the account. The equation above models the amount a, in dollars, that Jane has deposited after t weekly deposits. According to the model, how many dollars was Jane's initial deposit? (Disregard the $ sign when gridding your answer.)

36



In the figure above, point O is the center of the circle, line segments LM and MN are tangent to the circle at points L and N, respectively, and the segments intersect at point M as shown. If the circumference of the circle is 96, what is the length of minor arc $\overset{\frown}{LN}$?

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CONTINUE

Questions 37 and 38 refer to the following information.

A botanist is cultivating a rare species of plant in a controlled environment and currently has 3000 of these plants. The population of this species that the botanist expects to grow next year, $N_{\text{next year}}$, can be estimated from the number of plants this year, $N_{\text{this year}}$, by the equation below.

$$N_{\text{next year}} = N_{\text{this year}} + 0.2\left(N_{\text{this year}}\right)\left(1 - \frac{N_{\text{this year}}}{K}\right)$$

The constant K in this formula is the number of plants the environment is able to support.

37

According to the formula, what will be the number of plants two years from now if $K = 4000$? (Round your answer to the nearest whole number.)

38

The botanist would like to increase the number of plants that the environment can support so that the population of the species will increase more rapidly. If the botanist's goal is that the number of plants will increase from 3000 this year to 3360 next year, how many plants must the modified environment support?

STOP

If you finish before time is called, you may check your work on this section only. Do not turn to any other section.

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