2013–2014 MATHCOUNTS® School Handbook

Contains 300 creative math problems
that meet NCTM standards for grades 6-8.

For questions about your local MATHCOUNTS program,
please contact your chapter (local) coordinator. Coordinator contact
information is available through the Find My Coordinator
link on www.mathcounts.org/competition.

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Acknowledgments

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Count Me In!

A contribution to the MATHCOUNTS Foundation will help us continue to make this worthwhile program available to middle school students nationwide.

The MATHCOUNTS Foundation will use your contribution for programwide support to give thousands of students the opportunity to participate.

To become a supporter of MATHCOUNTS, send your contribution to:

MATHCOUNTS Foundation
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Or give online at:

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- Ask your employer about matching gifts. Your donation could double.
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For more information regarding contributions, call the director of development at 703-299-9006, ext. 103 or e-mail info@mathcounts.org.

The MATHCOUNTS Foundation is a 501(c)3 organization. Your gift is fully tax deductible.

The National Association of Secondary School Principals has placed this program on the NASSP Advisory List of National Contests and Activities for 2013–2014.

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The MATHCOUNTS Foundation makes its products and services available on a nondiscriminatory basis. MATHCOUNTS does not discriminate on the basis of race, religion, color, creed, gender, physical disability or ethnic origin.

CRITICAL 2013-2014 DATES

2013

Sept. 3 - Dec. 13 — Send in your school's Competition Series Registration Form to participate in the Competition Series and to receive the 2013-2014 School Competition Kit, with a hard copy of the *2013-2014 MATHCOUNTS School Handbook*. Kits begin shipping shortly after receipt of your form, and mailings continue every two weeks through December 31, 2013.

Mail, e-mail or fax the MATHCOUNTS Competition Series Registration Form with payment to:

MATHCOUNTS Registration, P.O. Box 441, Annapolis Junction, MD 20701
E-mail: reg@mathcounts.org
Fax: 240-396-5602

Questions? Call 301-498-6141 or confirm your registration via www.mathcounts.org/competitionschools.

Nov. 1 — The 2014 School Competition will be available. With a username and password, a registered coach can download the competition from www.mathcounts.org/CompetitionCoaches.

Nov. 15 — **Deadline to register for the Competition Series *at reduced registration rates*** ($90 for a team and $25 for each individual). After Nov. 15, registration rates will be $100 for a team and $30 for each individual.

Dec. 13 (postmark) — **Competition Series Registration Deadline**
In some circumstances, late registrations might be accepted at the discretion of MATHCOUNTS and the local coordinator. ***Late fees may also apply. Register on time to ensure your students' participation.***

2014

Early Jan. — If you have not been contacted with details about your upcoming competition, call your local or state coordinator! ***If you have not received your School Competition Kit by the end of January, contact MATHCOUNTS at 703-299-9006.***

Feb. 1-28 — **Chapter Competitions**

March 1-31 — **State Competitions**

May 9 — **2014 Raytheon MATHCOUNTS National Competition in Orlando, FL.**

INTRODUCTION TO THE NEW LOOK OF MATHCOUNTS®

Although the names, logos and identifying colors of the programs have changed, the mission of MATHCOUNTS remains the same: to provide fun and challenging math programs for U.S. middle school students in order to increase their academic and professional opportunities. Currently in its 31st year, MATHCOUNTS meets its mission by providing three separate, but complementary, programs for middle school students: the **MATHCOUNTS Competition Series**, **The National Math Club** and the **Math Video Challenge**. This *School Handbook* supports each of these programs in different ways.

MATHCOUNTS® COMPETITION SERIES
EST. 1983

The **MATHCOUNTS Competition Series**, formerly known as the Competition Program, is designed to excite and challenge middle school students. With four levels of competition - school, chapter (local), state and national - the Competition Series provides students with the incentive to prepare throughout the school year to represent their schools at these MATHCOUNTS-hosted* events. MATHCOUNTS provides the preparation and competition materials, and with the leadership of the National Society of Professional Engineers, more than 500 Chapter Competitions, 56 State Competitions and the National Competition are hosted each year. These competitions provide students with the opportunity to go head-to-head against their peers from other schools, cities and states; to earn great prizes individually and as members of their school team; and to progress to the 2014 Raytheon MATHCOUNTS National Competition in Orlando, Florida. There is a registration fee for students to participate in the Competition Series, and participation past the School Competition level is limited to the top 10 students per school.

Working through the* School Handbook *and previous competitions is the best way to prepare for competitions. *A more detailed explanation of the Competition Series is on pages 42 through 53.*

THE NATIONAL MATHCLUB
powered by MATHCOUNTS®

The National Math Club, formerly known as the MATHCOUNTS Club Program or MCP, is designed to increase enthusiasm for math by encouraging the formation within schools of math clubs that conduct fun meetings with a variety of math activities. The resources provided through The National Math Club are also a great supplement for classroom teaching. The activities provided for The National Math Club foster a positive social atmosphere, with a focus on students working together as a club to earn recognition and rewards in The National Math Club. All rewards require a minimum number of club members (based on school/organization/group size) to participate. Therefore, there is an emphasis on building a strong club and encouraging more than just the top math students within a school to join. There is no cost to sign up for The National Math Club, but a National Math Club Registration Form must be submitted to receive the free Club in a Box, containing a variety of useful club materials. (Note: A school that registers for the Competition Series is NOT automatically signed up for The National Math Club. A separate registration form is required.)

The* School Handbook *is supplemental to The National Math Club. Resources in the* Club Activity Book *will be better suited for more collaborative and activities-based club meetings.
More information about The National Math Club can be found at www.mathcounts.org/club.

*While MATHCOUNTS provides an electronic version of the actual School Competition Booklet with the questions, answers and procedures necessary to run the School Competition, the administration of the School Competition is up to the MATHCOUNTS coach in the school. The School Competition is not required; selection of team and individual competitors for the Chapter Competition is entirely at the discretion of the school coach and need not be based solely on School Competition scores.

MATHVIDEO CHALLENGE
produced by MATHCOUNTS®

The **Math Video Challenge** is an innovative program involving teams of students using cutting-edge technology to create videos about math problems and their associated concepts. This competition excites students about math while allowing them to hone their creativity and communication skills. Students form teams consisting of four students and create a video based on one of the Warm-Up or Workout problems included in this handbook. In addition, students are able to form teams with peers from around the country. As long as a student is a 6th, 7th or 8th grader, he or she can participate. Each video must teach the solution to the selected math problem, as well as demonstrate the real-world application of the math concept used in the problem. All videos are posted to videochallenge.mathcounts.org, where the general public votes on the best videos. The top 100 videos undergo two rounds of evaluation by the MATHCOUNTS judges panel. The panel will announce the top 20 videos and then identify the top four finalist videos. Each of the four finalist teams receives an all-expenses-paid trip to the 2014 Raytheon MATHCOUNTS National Competition, where the teams will present their videos to the 224 students competing in that event. The national competitors then will vote for one of the four videos to be the winner of the Math Video Challenge. Each member of the winning team will receive a $1000 college scholarship.

The School Handbook provides the problems from which students must choose for the Math Video Challenge.
More information about the Math Video Challenge can be found at videochallenge.mathcounts.org.

ALSO NEW THIS YEAR

THE MATHCOUNTS SOLVE-A-THON

MATHCOUNTS SOLVE-A-THON

This year, MATHCOUNTS is pleased to announce the launch of the MATHCOUNTS Solve-A-Thon, a new fundraising event that empowers students and teachers to use math to raise money for the math programs at their school. Starting September 3, 2013, teachers and students can sign up for Solve-A-Thon, create a personalized Fundraising Page online and begin collecting donations and pledges from friends and family members.

After securing donations, students go to their Solve-A-Thon Profile Page and complete an online Solve-A-Thon Problem Pack, consisting of 20 multiple-choice problems. A Problem Pack is designed to take a student 30-45 minutes to complete. Supporters can make a flat donation or pledge a dollar amount per problem attempted in the online Problem Pack. Schools must complete their Solve-A-Thon fundraising event by January 31, 2014.

All of the money raised through Solve-A-Thon, 100% of it, goes directly toward math education in the student's school and local community, and students can win prizes for reaching particular levels of donations. For more information and to sign up, visit solveathon.mathcounts.org.

RELATIONSHIP BETWEEN COMPETITION AND CLUB PARTICIPATION

The MATHCOUNTS Competition Series was formerly known as the Competition Program. However, no eligibility rules or testing rules have changed. The only two programmatic changes for the Competition Series are how it is related to The National Math Club (formerly the MATHCOUNTS Club Program).

(1) Competition Series schools are no longer automatically registered as club schools. In order for competition schools to receive all of the great resources in the Club in a Box, the coach must complete The National Math Club Registration Form (on page 87 or online at www.mathcounts.org/clubreg). Participation in The National Math Club and all of the accompanying materials still are completely free but do require a separate registration.

(2) To attain Silver Level Status in The National Math Club, clubs are no longer required to complete five monthly challenges. Rather, the Club Leader simply must attest to the fact that the math club met five times with the appropriate number of students at each meeting (usually 12 students; dependent on the size of the school). Because of this more lenient requirement, competition teams/clubs can more easily attain Silver Level Status without taking practice time to complete monthly club challenges. It is considerably easier now for competition teams to earn the great awards and prizes associated with Silver Level Status in The National Math Club. The Silver Level Application is included in the Club in a Box, which is sent to schools after registering for The National Math Club.

ELIGIBILITY FOR THE NATIONAL MATH CLUB

Starting with this program year, eligibility for The National Math Club (formerly the MATHCOUNTS Club Program) has changed. Non-school-based organizations and any groups of at least four students not affiliated with a larger organization are now allowed to register as a club. (Note that registration in the Competition Series remains for schools only.) In order to register for The National Math Club, participating students must be in the 6th, 7th or 8th grade, the club must consist of at least four students and the club must have regular in-person meetings. In addition, schools and organizations may register multiple clubs.

Schools that register for the Competition Series will no longer be automatically enrolled in The National Math Club. Every school/organization/group that wishes to register a club in The National Math Club must submit a National Math Club Registration Form, available at the back of this handbook or at www.mathcounts.org/club.

PROGRESSION IN THE NATIONAL MATH CLUB

Progression to Silver Level Status in The National Math Club will be based solely on the number of meetings a club has and the number of members attending each meeting. Though requirements are based on the size of the school/organization/group, the general requirement is having at least 12 members participating in at least five club meetings. Note that completing monthly challenges is no longer necessary. Progression to Gold Level Status in The National Math Club is based on completion of the Gold Level Project by the math club. Complete information about the Gold Level Project can be found in the *Club Activity Book*, which is sent once a club registers for The National Math Club. Note that completing an Ultimate Math Challenge is no longer the requirement for Gold Level Status.

HELPFUL RESOURCES

INTERACTIVE MATHCOUNTS PLATFORM

This year, MATHCOUNTS is pleased to offer the *2011-2012, 2012-2013* and *2013-2014 MATHCOUNTS School Handbooks* and the 2012 and 2013 School, Chapter and State Competitions online (www.mathcounts.org/handbook). This content is being offered in an interactive format through NextThought, a software technology company devoted to improving the quality and accessibility of online education.

The NextThought platform provides users with online, interactive access to problems from Warm-Ups, Workouts, Stretches and competitions. It also allows students and coaches to take advantage of the following features:

- Students can highlight problems, add notes, comments and questions, and show their work through digital whiteboards. All interactions are contextually stored and indexed within the *School Handbook*.
- Content is accessible from any computer with a modern web browser, through the cloud-based platform.
- Interactive problems can be used to assess student or team performance.
- With the ability to receive immediate feedback, including solutions, students develop critical-thinking and problem-solving skills.

- An adaptive interface with a customized math keyboard makes working with problems easy.
- Advanced search and filter features provide efficient ways to find and access MATHCOUNTS content and user-generated annotations.
- Students can build their personal learning networks through collaborative features.
- Opportunities for synchronous and asynchronous communication allow teams and coaches flexible and convenient access to each other, building a strong sense of community.
- Students can keep annotations private or share them with coaches, their team or the global MATHCOUNTS community.
- Digital whiteboards enable students to share their work with coaches, allowing the coaches to determine where students need help.
- Live individual or group chat sessions can act as private tutoring sessions between coaches and students or can be de facto team practice if everyone is online simultaneously.
- The secure platform keeps student information safe.

THE MATHCOUNTS OPLET
(Online Problem Library and Extraction Tool)

. . . a database of thousands of MATHCOUNTS problems AND step-by-step solutions, giving you the ability to generate worksheets, flash cards and Problems of the Day

Through www.mathcounts.org, MATHCOUNTS is offering the MATHCOUNTS OPLET - a database of 13,000 problems and over 5,000 step-by-step solutions, with the ability to create personalized worksheets, flash cards and Problems of the Day. After purchasing a 12-month subscription to this online resource, the user will have access to *MATHCOUNTS School Handbook* problems and MATHCOUNTS competition problems from the past 13 years and the ability to extract the problems and solutions in personalized formats. (Each format is presented in a pdf file to be printed.) The personalization is in the following areas:

• Format of the output: Worksheet, Flash Cards or Problems of the Day
• Number of questions to include
• Solutions (whether to include or not for selected problems)
• Math concept: Arithmetic, Algebra, Geometry, Counting and Probability, Number Theory, Other or a Random Sampling
• MATHCOUNTS usage: Problems without calculator usage (Sprint Round/Warm-Up), Problems with calculator usage (Target Round/Workout/Stretch), Team problems with calculator usage (Team Round), Quick problems without calculator usage (Countdown Round) or a Random Sampling
• Difficulty level: Easy, Easy/Medium, Medium, Medium/Difficult, Difficult or a Random Sampling
• Year range from which problems were originally used in MATHCOUNTS materials: Problems are grouped in five- year blocks in the system.

SAVE
$25 OFF

YOUR SUBSCRIPTION FEE IF YOU PURCHASE OPLET BEFORE
October 12, 2013.

Use code **OPLET1314** to receive your discount when registering online as a NEW subscriber.

Use code **RENEW1314** to receive your discount when renewing a current subscription.

MATHCOUNTS®

www.mathcounts.org/OPLET

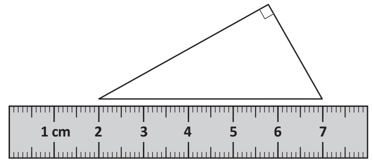
How does a person gain access to this incredible resource as soon as possible?

A 12-month subscription to the MATHCOUNTS OPLET can be purchased at www.mathcounts.org/oplet. The cost of a subscription is $275; however, schools registering students in the MATHCOUNTS Competition Series will receive a $5 discount per registered student. If you purchase OPLET before October 12, 2013, you can save a total of $75* off your subscription. Please refer to the coupon above for specific details.

*The $75 savings is calculated using the special $25 offer plus an additional $5 discount per student registered for the MATHCOUNTS Competition Series, up to 10 students.

Warm-Up 1

1. __________ cm What is the length, to the nearest centimeter, of the hypotenuse of the right triangle shown?



2. __________ cm If the ratio of the length of a rectangle to its width is $\frac{9}{4}$ and its length is 18 cm, what is the width of the rectangle?

3. __________ bins Mike bought $2\frac{3}{4}$ pounds of rice. He wants to distribute it among bins that each hold $\frac{1}{3}$ pound of rice. How many bins can he completely fill?

4. _____ : _____ p.m. It took Jessie 15 minutes to drive to the movie theater from home. He waited 10 minutes for the movie to start, and the movie lasted 1 hour 43 minutes. After the movie ended, Jessie immediately went home. It took Jessie 25 minutes to drive home from the theater. If he left for the movie at 4:05 p.m., at what time did he get home?

5. $ __________ A carnival pass costs $15 and is good for 10 rides. This is a savings of $2.50 compared to paying the individual price for 10 rides. What is the individual price of a ride without the pass?

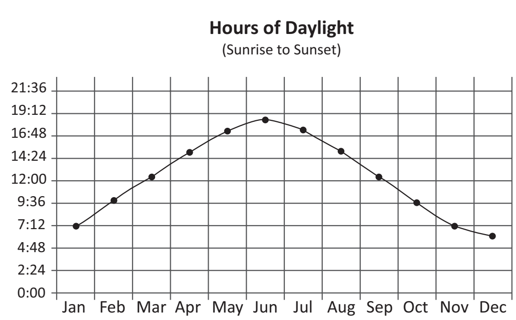
6. __________ If $x + y = 7$ and $x - y = 1$, what is the value of the product $x \cdot y$?

7. __________ Mrs. Stephens has a bag of candy. The ratio of peppermints to chocolates is 5:3, and the ratio of peppermints to gummies is 3:4. What is the ratio of chocolates to gummies? Express your answer as a common fraction.

8. __________ degrees The angles of a triangle form an arithmetic progression, and the smallest angle is 42 degrees. What is the degree measure of the largest angle of the triangle?

9. __________ Each of the books on Farah's shelves is classified as sci-fi, mystery or historical fiction. The probability that a book randomly selected from her shelves is sci-fi equals 0.55. The probability that a randomly selected book is mystery equals 0.4. What is the probability that a book selected at random from Farah's shelves is historical fiction? Express you answer as a decimal to the nearest hundredth.

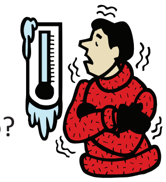
10. __________



According to the graph shown, which of the other eleven months has a number of daylight hours most nearly equal to the number of daylight hours in April?

Warm-Up 2

11. ___________ Consider the following sets: A = {2, 5, 6, 8, 10, 11}, B = {2, 10, 18} and C = {10, 11, 14}. What is the greatest number in either of sets B or C that is also in set A?



12. ___________ °F The temperature is now 0 °F. For the past 12 hours, the temperature has been decreasing at a constant rate of 3 °F per hour. What was the temperature 8 hours ago?

13. ___________ What is the value of x if $\frac{1}{x} + \frac{1}{2x} = \frac{1}{2}$?

14. ___________ In June, Casey counted the months until he would turn 16, the minimum age at which he could obtain his driver's license. If the number of months Casey counted until his birthday was 45, in what month would Casey turn 16?

15. ___________ buckets It takes 1 gallon of floor wax to cover 600 ft^2. If floor wax is sold only in 1-gallon buckets, how many buckets of floor wax must be purchased to wax the floors of three rooms, each measuring 20 feet by 15 feet?

16. ___________ Consider the pattern below:

$22^2 = 121 \times (1 + 2 + 1)$

$333^2 = 12{,}321 \times (1 + 2 + 3 + 2 + 1)$

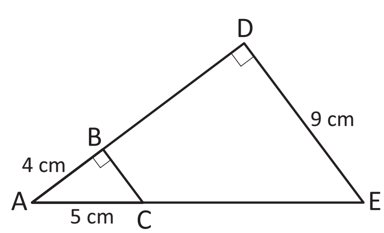
$4444^2 = 1{,}234{,}321 \times (1 + 2 + 3 + 4 + 3 + 2 + 1)$

For what positive value of n will $n^2 = 12{,}345{,}654{,}321 \times (1 + 2 + 3 + 4 + 5 + 6 + 5 + 4 + 3 + 2 + 1)$?

17. ___________ times If United States imports increased 20% and exports decreased 10% during a certain year, the ratio of imports to exports at the end of the year was how many times the ratio at the beginning of the year? Express your answer as a common fraction.

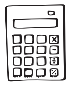
18. ___________ James needs \$150 to buy a cell phone. In January, he saved \$5. He saved twice as much in February as he saved in January, for a total savings of \$15. If James continues to save twice as much each month as he saved the previous month, in what month will his total savings be enough to purchase the cell phone?

19. ___________ cm What is the perimeter of $\triangle ADE$ shown here?



20. ___________ females The following table shows the results of a survey of a random sample of people at a local fair. If there are 1100 people at the fair, how many females would you expect to prefer the Flume?

Favorite Ride	**Male**	**Female**
Ferris Wheel	15	20
Roller Coaster	24	14
Carousel	6	10
Flume	5	6



Workout 1

21. __________ hours It takes Natasha nine hours to mow six lawns. On average, how many hours does it take her to mow each lawn? Express your answer as a decimal to the nearest tenth.

22. __________ What is the value of $(\pi^4 + \pi^5)^{\frac{1}{6}}$ when expressed as a decimal to the nearest hundredth?

23. __________ cm What is the length of a diagonal that cuts through the center of a cube with edge length 4 cm? Express your answer in simplest radical form.

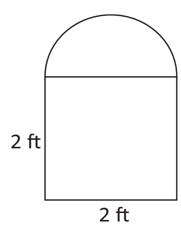
24. $__________ Carol finds her favorite brand of jeans on sale for 20% off at the mall. If the jeans are regularly $90 and the tax is 7.5%, how much will she pay for one pair of jeans?

25. __________ What is the value of 1 + 1 when written in base 2?

26. __________ euros In May 2002, the exchange rate for converting U.S. dollars to euros was 1 dollar = 1.08 euros. At this rate, 250 U.S. dollars could be exchanged for how many euros?

27. __________ units Two sides of a right triangle have lengths 5 units and 12 units. If the length of its hypotenuse is not 13 units, what is the length of the third side? Express your answer in simplest radical form.

28. __________ ft^2



A Norman window has the shape of a rectangle on three sides, with a semicircular top. This particular Norman window includes a 2-foot by 2-foot square. What is the area of the whole window? Express your answer as a decimal to the nearest hundredth.

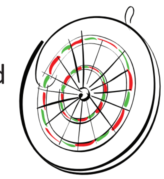
29. __________ A fair coin is flipped, and a standard die is rolled. What is the probability that the coin lands heads up and the die shows a prime number? Express your answer as a common fraction.

30. __________ in^3 Bailey is estimating the volume of a container. The container is a cube that measures 2 feet 7 inches on each edge. Bailey estimates the volume by using 3 feet for each edge. In cubic inches, what is the positive difference between Bailey's estimate and the actual volume?

Warm-Up 3

31. __________ If the ratio of a to b is $\frac{7}{3}$, what is the ratio of $2a$ to b? Express your answer as a common fraction.

32. __________ Remy throws three darts and Rita throws one dart at a dartboard. Each dart lands at a different distance from the center. Assuming Remy and Rita are equally skilled at darts, what is the probability that the dart closest to the center is one that Remy threw? Express your answer as a common fraction.



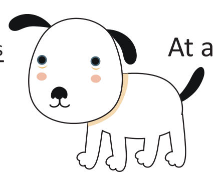
33. __________ Grace had an average test score of exactly 89 in her algebra class after the first three tests. After the fourth test, her average was exactly 91. What was Grace's score on the fourth test?

34. ________ cm^3 What is the volume, in cubic centimeters, of a cube that has a surface area of 96 cm^2?

35. __________ If 45% of the students at South Park High School were born at South Park Hospital, what is the ratio of the number of students who were not born at South Park Hospital to the number of students who were born at South Park Hospital? Express your answer as a common fraction.

36. __________ If $\frac{c}{d} = 4$, what is the value of $\frac{d}{c} + \frac{1}{2}$? Express your answer as a common fraction.

37. ________ dogs



At a pet store, there are 23 animals. Among the animals in the store, 15 are white, 5 are white dogs and 7 animals are neither dogs nor white. How many dogs are at the pet store?

38. __________ Yoon is expecting an important phone call today at a randomly selected time from 2:00 p.m. to 3:30 p.m. What is the probability that he will receive the call before 2:15 p.m.? Express your answer as a common fraction.

39. ________ quarts Donatella's recipe for punch calls for the following ingredients:

$\frac{1}{2}$ gallon of apple juice
3 cups of lemon-lime soda
64 fluid ounces of pineapple juice
2 quarts of cold water
1 cup of lemon juice

One gallon = 4 quarts = 8 pints = 16 cups = 128 fluid ounces. How many quarts of punch will this recipe produce?

40. ________ cookies Jude ate 100 cookies in five days. On each day, he ate 6 more than on the previous day. How many cookies did he eat on the fifth day?

Warm-Up 4

41. __________ If the point (−3, 5) is reflected across the *x*-axis, what is the sum of the coordinates of the image?

42. __________ Let @*x*@ be defined for all positive integer values of *x* as the product of all of the factors of 2*x*. For example, @7@ = 14 × 7 × 2 × 1 = 196. What is the value of @3@?

43. ________ feet The peak of Mount Everest is approximately 29,000 feet above sea level. The bottom of the Mariana Trench is approximately 36,201 feet below sea level. What is the vertical distance, to the nearest thousand, from the base of the Mariana Trench to the peak of Mount Everest?

44. __________ What is the mean of $7\frac{1}{2}$, $-3\frac{1}{4}$, 4, $-5\frac{1}{4}$ and 2?

45. __________ If $45 + \sqrt{c} = 49$, what is the value of $c^2 - 21$?

46. ________ weeks Spending at a rate of 100 dollars every minute, how many weeks will it take Janelle to spend one million dollars? Express your answer to the nearest whole number.

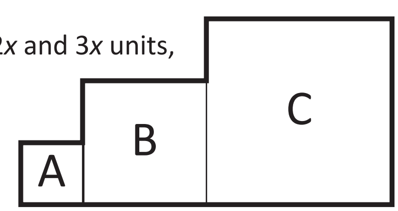
47. __________ What is the value of $(-20) + (-17) + (-14) + \cdots + 13 + 16 + 19 + 22$?

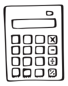
48. ________ cm The area of a right triangle is 36 cm^2. If the length of one leg of this triangle is 8 cm, what is the length of the other leg, in centimeters?

49. __________

There is a $\frac{2}{3}$ chance of rain for each of three days. If the weather on each day is independent of the weather on the other two days, what is the probability that it will rain on none of the three days? Express your answer as a common fraction.

50. ________ units Squares A, B and C, shown here, have sides of length *x*, 2*x* and 3*x* units, respectively. What is the perimeter of the entire figure? Express your answer in terms of *x*.

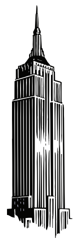




Workout 2

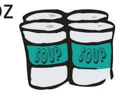
51. __________ The line passing through points (1, c) and (−5, 3) is parallel to the line passing through the points (4, 3) and (7, −2). What is the value of c?

52. ______ minutes



The book of *Guinness World Records* states that Fuatai Solo set a world record in 1980 by climbing a coconut tree 29 feet 6 inches tall in 4.88 seconds. At that rate, how many minutes would it take Fuatai to climb the 1454 feet to the top of the Empire State Building? Express your answer to the nearest whole number.

53. ______ cents At a store, a four-pack of 16-oz cans of soup costs \$3.20 and a three-pack of 24-oz cans costs \$3.60. How many cents are in the absolute difference between the price per ounce of a four-pack and the price per ounce of a three-pack?



54. __________ What is the closest integer to the real number x such that 2^x=1000?

55. ______ feet A wheel that makes 10 revolutions per minute takes 18 seconds to travel 15 feet. In feet, what is the diameter of the wheel? Express your answer as a decimal to the nearest tenth.

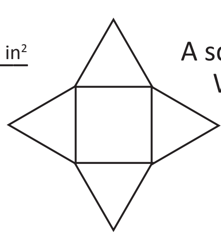
56. ______ years The average age of a group of 12 people is 26 years. If 8 new people are added to the group, the average age of the group increases to 32 years. In years, what is the average age of the 8 new people?

57. __________ Connie and her little brother like to play a number game. When Connie says a number, her brother then says the number that is 3 less than half of Connie's number. If Connie says a number, and her brother gives the correct response, 9, what number did Connie say?

58. ______ pounds Arnold, Benji and Celal found an old scale. When Arnold and Benji stepped on the scale, it showed a weight of 158 pounds. When Benji and Celal stepped on the scale, it showed a weight of 176 pounds. When all three of them stepped on the scale, it accurately showed a weight of 250 pounds but then promptly broke under the strain. However, they already had enough information to determine each of their weights. How much does Benji weigh?

59. ______ odd numbers Of all three-digit natural numbers less than 523, how many of the odd numbers contain no 5?

60. ______ in^2



A square of side length 4 inches has four equilateral triangles attached as shown. What is the total area of this figure? Express your answer in simplest radical form.

Warm-Up 5

61. ______ What number must be added to the set {5, 10, 15, 20, 25} to increase the mean by 5?

62. ______ For each pair (x, y) in the table shown, $y = \frac{c}{x}$ where c is a constant. What is the value of c?

x	$-\frac{1}{2}$	−1	−2	−4
y	−16	−8	−4	−2

63. ___:___ p.m. Sinclair is going to visit her family in New York. She lives 90 miles away in New Jersey. Assuming that there are no traffic delays and she can travel at an average speed of 45 mi/h for the entire trip, at what time should she leave if she needs to meet her family at 4:00 p.m.?

64. ______ knots A ship is 108 feet long and travels on open water at a speed of 30 knots. A model of the ship that is 12 feet long is used to test its hydrodynamic properties. To replicate the wave pattern that appears behind a ship, the speed of the model, r, should be equal to $r = s\sqrt{\frac{m}{a}}$, where s is the speed of the actual ship, a is the length of the actual ship and m is the length of the model. What speed, in knots, should be used for the model to simulate travel in open water?

65. ______ What fraction of 45 is 60% of 50? Express your answer as a common fraction.

66. ______ The integer x is the sum of three different positive integers, each less than 10. The integer y is the sum of three different positive integers, each less than 20. What is the greatest possible value of $\frac{y}{x}$?

67. ______ In the four by four grid shown, move from the 1 in the lower left corner to the 7 in the upper right corner. On each move, go up, down, right or left, but do not touch any cell more than once. Add the numbers as you go. What is the maximum possible value that can be obtained, including the 1 and the 7?

4	5	6	7
3	4	5	6
2	3	4	5
1	2	3	4

68. ______ complete pages

If a printer prints at a uniform rate of 3 complete pages every 40 seconds, how many complete pages will it print in 3 minutes?

69. ______ sides The measure of an interior angle of a regular polygon is eight times the measure of one of its exterior angles. How many sides does the polygon have?

70. ______ The number 101 is a three-digit palindrome because it remains the same when its digits are reversed. What is the ratio of the number of four-digit palindromes to the number of five-digit palindromes? Express your answer as a common fraction.

Warm-Up 6

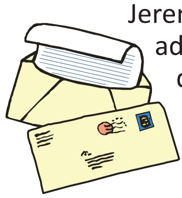
71. ________ values For how many nonzero values of x does $x^{2x} = 1$?

72. (____ , ____) The function $y = 3x + 6$ is graphed in the coordinate plane. At what point on the graph is the y-value double the x-value? Express your answer as an ordered pair.

73. ________ degrees The typical person spends 8 hours a day sleeping. In a circle graph that shows how 24 hours in a day are spent, how many degrees are in the central angle for sleeping?

74. __________ The average of a, b and c is 15. The average of a and b is 18. What is the value of c?

75. __________



Jeremiah has written four letters, one to each of four different people, and he has an addressed envelope for each person. If Jeremiah randomly places each letter in a different one of the four envelopes, what is the probability that two letters are in the correct envelopes and the other two are not? Express your answer as a common fraction.

76. __________ If the points $(-2, 5)$, $(0, y)$ and $(5, -16)$ are collinear, what is the value of y?

77. __________ If $(2x - 5)(2x + 5) = 5$, what is the value of $4x^2$?

78. $ __________ Arturo invests \$5000 in a mutual fund that gains 20% of its value in the first month, and then loses 20% of its value the following month. In dollars, how much is Arturo's investment worth at the end of the second month?

79. __________ What is the sum of the 31st through 36th digits to the right of the decimal point in the decimal expansion of $\frac{4}{7}$?

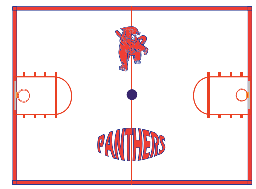
80. __________ What numeral in base 8 is equivalent to 332_5 (denoting 332 base 5)?

Workout 3

81. ________ mi/h A pilot flew a small airplane round-trip between his home airport and a city 720 miles away. The pilot logged 5 hours of flight time and noted that there was no wind during the flight to the city, but he did encounter a headwind on his return flight. If the pilot was able to maintain a speed of 295 mi/h during the flight to the city, what was his average speed during the return flight, in miles per hour? Express your answer as a decimal to the nearest hundredth.

82. ________ For nonzero numbers a, b and c, b is $\frac{1}{3}$ of a, and c is twice b. What is the value of $\frac{a^2}{c^2}$? Express your answer as a decimal to the nearest hundredth.

83. ________ ft^2 A rectangular basketball court had an area of 1200 ft^2. The court was enlarged so that its length was increased by 40% and its width by 50%. How many square feet larger than the original court is the new court?



84. ________ There are 300 members of the eighth-grade class at Woodlawn Beach Middle School, of whom 28 have Mr. Jackson for Algebra 1. Two members of the eighth-grade class will be selected at random to represent the school at an upcoming event. What is the probability that neither of the students selected will be from Mr. Jackson's Algebra 1 class? Express your answer as a decimal to the nearest hundredth.

85. $ ________ Matthew earns a regular pay rate of $8.80 per hour, before deductions, at his full-time job. If he works more than 40 hours in a week, he earns overtime at $1\frac{1}{2}$ times his normal pay rate for any time worked beyond 40 hours. All of his deductions combined are 35% of his gross pay. How much does Matthew earn after deductions if he works 48 hours in one week?

86. ________ books

According to one estimate, a new book is published every 13 minutes in the United States. Based on this estimate, how many books will be published in the year 2014? Express your answer to the nearest whole number.

87. ________ feet Stephen took a ride on a circular merry-go-round. The horse Stephen rode was at a distance of 15 feet from the center of the merry-go-round. If the ride made exactly $2\frac{3}{4}$ revolutions, how many feet did Stephen travel? Express your answer as a common fraction in terms of π.

88. ________ degrees The absolute difference between the measure of an acute angle and the measure of its supplement is 136 degrees. What is the degree measure of the acute angle?

89. ________ For what fraction of the day is the hour hand or minute hand (or both the hour and minute hands) of an analog clock in the upper half of the clock? Express your answer as a common fraction.

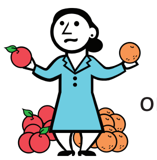
90. ________ m What is the height of a right square pyramid whose base measures 48 m on each side and whose slant height is 72 m? Express your answer as a decimal to the nearest hundredth.

Warm-Up 7

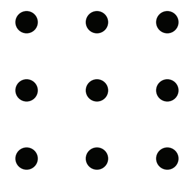
91. __________ If positive integers p, q and $p + q$ are all prime, what is the least possible value of pq?

92. __________ Two concentric circles have radii of x and $3x$. The absolute difference of their areas is what fraction of the area of the larger circle? Express your answer as a common fraction.

93. __________ To unlock her mobile device, Raynelle must enter the four different digits of her security code in the correct order. Raynelle remembers the four different digits in her security code. However, since she can't recall their order, she enters the four digits in a random order. What is the probability that the security code Raynelle enters will unlock her device? Express your answer as a common fraction.

94. __________  Penny has $4x$ apples and $7y$ oranges. If she has the same number of apples and oranges, what is the ratio of x to y? Express your answer as a common fraction.

95. ________ sides A polygon is made in this grid of 9 dots, by connecting pairs of dots with line segments. At each vertex there is a dot joining exactly two segments. What is the greatest possible number of sides of a polygon formed in this way?



96. __________ If $f(x) = x^2 + 3x - 4$ and $g(x) = \frac{3}{4}x + 6$, what is $g(-8) - f(-2)$?

97. ________ hours As Gregory enters his room for the night, he glances at the clock. It says 9:12 p.m. He listens to music and checks his social media page for half an hour. He then spends 15 minutes getting ready for bed. If he falls asleep 8 minutes after he climbs into bed and wakes up at 8:00 a.m. the next day, for how many hours was he asleep? Express your answer as a mixed number.

98. __________ If $\frac{x}{y} = \frac{3}{4}$ and $\frac{x}{z} = \frac{1}{8}$, what is the value of $\frac{y}{z}$? Express your answer as a common fraction.

99. $ _________ Bright Middle School has budgeted \$10,000 to purchase computers and printers. Using the full amount budgeted, the school can buy 10 computers and 10 printers or 12 computers and 2 printers. What is the cost of 1 computer, in dollars?

100. $ ________ Last year, David earned money by performing odd jobs for his neighbors, and he had no other source of income. The combined amount David earned during January, February and March was $\frac{1}{12}$ of his total income. During April, May and June, combined, he earned $\frac{1}{6}$ of his total income. David earned $\frac{1}{2}$ of his total income during July, August and September. If the combined amount he earned during October, November and December was \$2,000, what was his total income last year?

Warm-Up 8

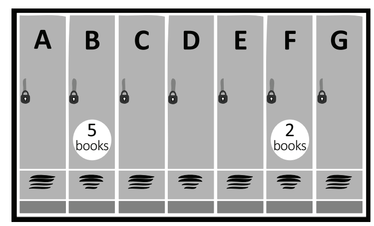
101. ______ segments Sebi has a string that is 1.75 m long. What is the greatest number of segments, each 10 cm in length, that he can cut from this string?

102. ______ children  A group of children stopped to buy ice cream from a stand that sold 9 different flavors of ice cream. When every child in the group had purchased one double-scoop cone with two different flavors, every possible two-flavor combination had been served exactly once. If none of the children purchased the same two flavors, how many children were there in the group?

103. __________ The result of multiplying a number by 5 is the same as adding it to 5. What is the number? Express your answer as a common fraction.

104. ______ feet For a certain rectangle, its perimeter, in feet, and area, in square feet, are numerically equal. If the length of the rectangle is 8 feet, what is its width? Express your answer as a mixed number.

105. ______ books Lockers A through G are arranged side by side as shown, with lockers B and F containing exactly 5 books and exactly 2 books, respectively. In one of the other five lockers, there are exactly 8 books, in another exactly 7 books, in another locker exactly 5 books, in one other only 2 books, and one locker contains no books. The number of books in each of the lockers A through G is such that the total number of books contained in any two adjacent lockers is different from the number of books in each of the other five lockers. For example, the total number of books contained in lockers A and B is different from the number of books in each of the lockers labeled C, D, E, F and G. What is the combined number of books in lockers A and G?



106. ______ units The center of a circle in a rectangular coordinate system has the coordinates $(-8, -3)$. What is the radius of the circle if the circle touches the y-axis at only one point?

107. ______ dollars Barbara's allowance is x cents per day. How many dollars in allowance will Barbara receive during the month of June? Express your answer as a common fraction in terms of x.

108. ______ units^2 What is the absolute difference between the largest and smallest possible areas of two rectangles that each have a perimeter of 46 units and integer side lengths?

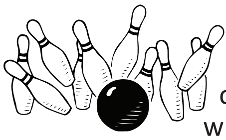
109. ______ men In a group of 212 men and women, there were 32 more men than women. How many men were in the group?

110. ______ socks A drawer contains five brown socks, five black socks and five gray socks. Randomly selecting socks from this drawer, what is the minimum number of socks that must be selected to guarantee at least two matching pairs of socks? A matching pair is two socks of the same color.

Workout 4

Year	% Change
2001	+10
2002	−5
2003	−10
2004	+4
2005	+4
2006	+4
2007	+4
2008	+4

111. ________ inches The Pine Lodge Ski Resort had exactly 200 inches of snowfall in 2000. The table shows the percent change in total snowfall for each year compared with the previous year. After 2003, what was the total snowfall, in inches, the year that the total snowfall first exceeded 200 inches? Express your answer as a decimal to the nearest hundredth.



112. ________ games Country Bowl charges \$2.60 for bowling shoe rental and \$4.00 for each game of bowling, with no charge for using their bowling balls. Super Bowl charges \$2.50 per game, but its charge for shoe and ball rental is \$7.10. For what number of games is the price the same at the two bowling alleys?

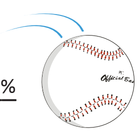
113. ________ dates A particular date is called a difference date if subtracting the month number from the day gives you the two-digit year. For example, June 29, 2023 and January 1, 2100 are difference dates since 29 − 6 = 23 and 1 − 1 = 00. Including these two dates, how many dates during the 21st century (January 1, 2001 to December 31, 2100) can be classified as difference dates?

114. ________ If the median of the ordered set $\{0, \frac{2}{5}x, x, 11.5x, 5, 9\}$ is 2, what is the mean? Express your answer as a decimal to the nearest hundredth.

115. \$________ Carmen bought new software for her computer for \$133.38, including 8% tax. What was the cost for the software before the tax was added?

116. ________ boxes Square tiles measuring 6 inches by 6 inches are sold in boxes of 10 tiles. What is the minimum number of boxes of tiles needed to exactly cover a rectangular floor that has dimensions 12 feet by 13 feet if only whole boxes can be purchased?

117. ________ pounds A giant panda bear must eat about 38% of its own weight in bamboo shoots or 15% of its own weight in bamboo leaves and stems each day. A male panda at the local zoo requires 49.35 pounds of bamboo leaves and stems daily. How much does the male panda weigh?



118. ________ % Suppose the yarn wrapped around the rubber core inside a major league baseball is 450 feet long. In 1991, Cecil Fielder made a home run by hitting a baseball an amazing 502 feet. By what percent does the length of Fielder's home run exceed the length of yarn used to create a major league baseball? Express your answer to the nearest hundredth.

119. ________ newtons The formula $P = F/A$ indicates the relationship between pressure (P), force (F) and area (A). In newtons, what is the maximum force that could be applied to a square area with side length 4 meters so that the pressure does not exceed 25 newtons per square meter?

120. ________ in^2 A cylindrical can has a label that completely covers the lateral surface of the can with no overlap. If the can is 6 inches tall and 4 inches in diameter, what is the area of the label? Express your answer as a decimal to the nearest tenth.

Warm-Up 9

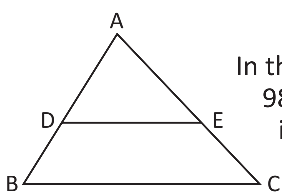
121. ________ feet A flea can jump 350 times the length of its own body. If a human were able to jump 350 times his or her height, how many feet would an average American, whose height is 5 feet 6 inches, be able to jump?

122. ________ people Of the 3 million people who auditioned for a television talent competition in the past 10 years, only 1% of 1% were selected to be contestants. How many people were selected to be contestants in this talent competition in the past 10 years?

123. ________ cans A rectangular room has a length, width and height of 15 feet, 12 feet and 8 feet, respectively. The room has one 30-inch by 60-inch window on each of the four walls. One wall also contains two 3-foot by 7-foot doors. If a can of paint is enough to cover an area of 100 ft^2, what is the minimum number of whole cans of paint needed to paint the walls and ceiling in this room?

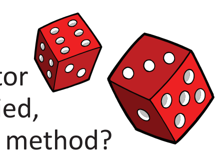
124. ________ dollars Together Brianna and Shanita have \$24.00. If Brianna has \$3.00 more than twice the amount of money Shanita has, how many more dollars than Shanita does Brianna have?

125. ________ m



In the figure, segment DE is parallel to segment BC. The area of $\triangle ABC$ is 98 m^2. The area of $\triangle ADE$ is 50 m^2. The perimeter of $\triangle ADE$ is 55 m. What is the perimeter, in meters, of $\triangle ABC$?

126. ________ fractions Two standard six-sided dice are rolled. One of the dice represents the numerator and the other represents the denominator of a fraction. The fraction is simplified, if possible. How many distinct fractions less than one can be generated by this method?

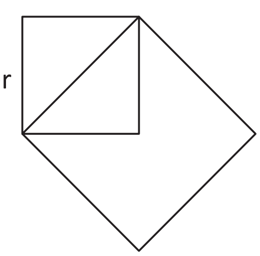


127. ________ dimes Rayshon has 51 coins consisting of dimes and nickels that total \$3.55. How many dimes does he have?

128. (___ , ___) A circle passes through the origin and (8, 0). It has a radius of 5, and its center is in the first quadrant. What are the coordinates of its center? Express your answer as an ordered pair.

129. ________ If $f(x) = -(x - 1)^2 + 2$, what is the greatest possible value of $f(x) + 3$?

130. ________ $units^2$ In the figure shown, a side of the larger square is a diagonal of the smaller square. If the area of the smaller square is 1 square unit, what is the area of the larger square?



Warm-Up 10

131. ________  A 2-cup mixture consists of $\frac{2}{3}$ cup of flour and the rest is nuts. If 1 cup of flour is added to make a 3-cup mixture, what fraction of the 3-cup mixture is flour? Express your answer as a common fraction.

132. ______ years Marshall's age is 53, and Cody's age is 17. How many years ago was Marshall four times as old as Cody was?

133. ______ houses The houses on Main Street have three-digit house numbers that begin with either 7 or 9. If the remaining digits must contain one even and one odd digit and cannot contain a 0, what is the greatest number of houses that could be on Main Street?

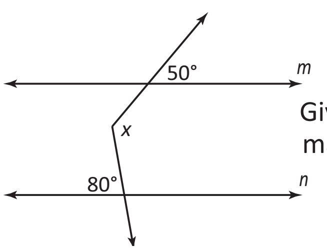
134. ______ mi/h What is the average speed of a cyclist who bikes up a hill at 6 mi/h but then bikes back along the same path down the hill at 12 mi/h?

135. ______ hours Shimdra is on vacation and wants to drive from Melbourne, Florida to Miami Beach, Florida.

The scale on the map is 1 inch = 16 miles. The map distance from Melbourne to Miami Beach is $11\frac{1}{4}$ inches. If Shimdra's average speed is 60 mi/h, how many hours will it take Shimdra to make the trip?

136. ________ What is the value of $\frac{(1.4 \times 10^{-7})(2.4 \times 10^{8})}{1.2 \times 10^{9}}$ when written in simplest form? Express your answer in scientific notation to two significant digits.

137. ______ degrees

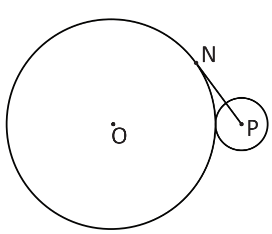


Given parallel lines *m* and *n* and the degree measures of the two marked angles, what is the degree measure of the angle marked *x*?

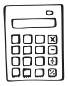
138. ______ students Three-year-old Sally attends a preschool class every weekday. One day, five new students were added to her class, after which there were $\frac{3}{2}$ as many students in Sally's preschool class as before. How many students were in the class before the addition of five new students?

139. ______ slugs Two cobbles and 3 burreys cost 19 slugs. If you subtract the cost of 5 cobbles from the cost of 37 slugs, you get the cost of 4 burreys. What is the total cost, in slugs, of 1 cobble and 1 burrey?

140. ______ cm



Circles O and P, of radius 16 cm and 4 cm, respectively, are tangent, as shown. Segment NP is tangent to circle O at point N. What is the length of segment NP?

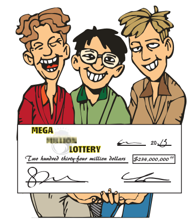


Workout 5

141. ________ units One cube has a volume that is 728 units^3 larger than that of a second cube. If the smaller cube has edge length 10 units, what is the number of units in the edge length of the larger cube?

142. ________ cm^2 A rectangle is inscribed in a circle of radius 5 cm. The base of the rectangle is 8 cm. What is the area of the rectangle?

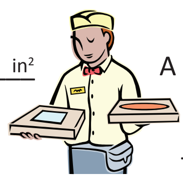
143. ________ % Three Maryland educators will split equally \$234 million from the Mega Million Lottery. Each will collect about \$53 million after taxes. What percentage of tax will be paid by each of the winners if the taxes also are split equally among the winners? Express your answer to the nearest whole number.



144. ________ A merchant alternately reduces and then increases the price of an item by 20%. After six price changes, the item is priced at *a*% of its original price. What is the value of *a*? Express your answer as a decimal to the nearest tenth.

145. ________ degrees When the sum of the degree measures of the acute angles of a scalene right triangle is divided by 8, what is the value of the quotient? Express your answer as a decimal to the nearest hundredth.

146. ________ in^2



A pizzeria sells a rectangular 18-inch by 24-inch pizza for the same price as its large round pizza with a 24-inch diameter. How many more square inches of pizza do you get with the round pizza for the same amount of money? Express your answer to the nearest whole number.

147. \$________ Kate notices that the cost of a week of electricity for air conditioning her house varies directly with the week's average outdoor temperature in degrees Fahrenheit. For a week in May, the average outdoor temperature was 81 °F and the air conditioning electricity bill was \$32.40. What will Kate's air conditioning electricity bill be for a week in August when the average outdoor temperature is 96 °F?

148. ________ feet Columbus ran one time around the perimeter of a rectangular field that measures 40 feet by 70 feet. Pythagoras ran from one corner to the opposite corner and back. How much farther did one of them run than the other? Express your answer as a decimal to the nearest tenth.

149. ________ children A couple getting married today can be expected to have 0, 1, 2, 3, 4 or 5 children with probabilities of 20%, 20%, 30%, 20%, 8% and 2%, respectively. What is the mean number of children a couple getting married today can be expected to have? Express your answer to the nearest whole number.

150. ________ quarters A collection of nickels, dimes and quarters is worth \$5.30. There are two more dimes than nickels and four more quarters than dimes. How many quarters are in this collection of coins?

Warm-Up 11

151. __________ The mean of seven numbers is 9. What is the new mean if each of the numbers is doubled?

152. __________ What is the 2013th digit after the decimal point when $\frac{1}{7}$ is expressed as a decimal?

153. __________ A number z is chosen at random from the set of positive integers less than 20. What is the probability that $\frac{19}{z} \geq z$? Express your answer as a common fraction.

154. __________ If $\frac{3}{4} = \frac{a}{36} = \frac{36}{b}$, what is the value of $a + b$?

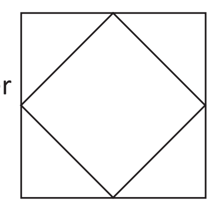
155. ______ degrees Some Mathletes® bought a circular pizza for \$10.80. Pat's share was \$2.25. Each student contributed to its cost based on the area of the fractional part he or she received. In degrees, what was the measure of the central angle of Pat's part?

156. ______ minutes

A pedestrian averages 3 mi/h on the streets of Manhattan, and a subway train averages 30 mi/h. If each city block is $\frac{1}{20}$ of a mile, how many more minutes than the subway train does it take for a pedestrian to travel 60 blocks in Manhattan?

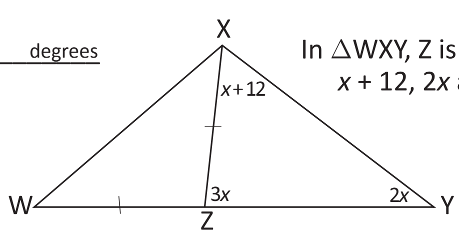
157. __________ Two different integers are randomly selected from the set of positive integers less than 10. What is the probability that their product is a perfect square? Express your answer as a common fraction.

158. ______ inches The figure shown here is to be made from a single piece of yarn. What is the shortest length of yarn that can be used to make the figure if each side of the outer square is 12 inches long and the vertices of the inner square each bisect a side of the outer square? Express your answer in simplest radical form.



159. ______ mi/h After driving along at a certain speed for 5 hours, Rich realizes that he could have covered the same distance in 3 hours if he had driven 20 mi/h faster. What is his current speed?

160. ______ degrees



In $\triangle WXY$, Z is on side WY and WZ = XZ. If the angles of $\triangle XYZ$ have measures $x + 12$, $2x$ and $3x$, as shown, what is the degree measure of $\angle W$?

Warm-Up 12

161. ________ km^2 If 1000 cubic meters of pine mulch can fertilize 0.02 square kilometers of soil, how many square kilometers of soil can be fertilized by 10^8 cubic meters of pine mulch?

162. ________ If $9^c = 27^{c-1}$, what is the value of c?

163. ________ Each term after the first term of the sequence 2, 4, 8, … is 2 times the preceding term. Each term after the first of sequence 10, 20, 30, … is 10 more than the preceding term. What is the least value of n such that the nth term of the first sequence is greater than the nth term of the second sequence ?

164. ________ combi-nations For the orchestra contest, Mrs. Treble is going to select 4 pieces of music from the recommended list of 20 pieces. How many combinations of 4 pieces of music are possible?

165. ________ integers How many of the first 500 positive integers are multiples of all three integers 3, 4 and 5?

166. ________ inches

The distance from the center of a clock to the tip of the minute hand is 4 inches. Between 2:45 p.m. and 7:15 p.m., what is the total distance traveled by the tip of the minute hand? Express your answer in terms of π.

167. ________ Nine people are forming three teams of three people each for a game of XFlag. Each team has one player who is the captain. The nine participants are Alana, Benny, Chico, Danzig, Elias, Frederico, Gina, Hsin-Hsin and Illiana. They are very particular about which players can be on a team together. Frederico must be with Hsin-Hsin or Illiana. Elias, Frederico and Gina must be on different teams. Hsin-Hsin and Illiana must be on different teams. Chico and Danzig must be on the same team; neither is a captain. Danzig cannot be on a team with Gina as captain. Frederico cannot be on a team with Alana as captain. Hsin-Hsin cannot be on a team with Elias as captain. Alana and Benny are captains. Who is the third captain?

168. ________ ft^2 In Figure 1, four congruent circles are inscribed in a square, and in Figure 2, sixteen congruent circles are inscribed in a square. Both squares measure 4 feet by 4 feet. What is the absolute difference between the shaded area in Figure 1 and the shaded area in Figure 2?

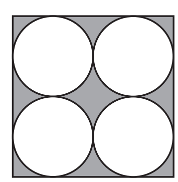


Figure 1

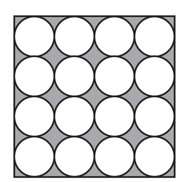
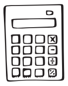


Figure 2

169. ________ If $x^2 + \frac{1}{x^2} = 3$, what is the value of $x^4 + \frac{1}{x^4}$?

170. ________ $units^2$ What is the area of the $\triangle JKL$ in the coordinate plane with vertices J(−3, 2), K(−1, −2) and L(5, 6)?



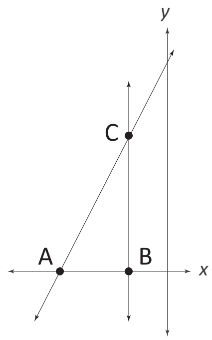
Workout 6

171. ________ Juwan purchased several coats from a manufacturer. He wants to sell the coats at his store for 60% more than he paid. By what number should he multiply the manufacturer's price to determine his price? Express your answer as a decimal to the nearest tenth.

172. ________ % What is the percent of increase in the volume of a cube when its edge length is increased by 50%? Express your answer to the nearest tenth.

173. ________ inches What is the perimeter of a 60-degree slice of a pizza with a 7-inch radius? Express your answer as a decimal to the nearest tenth.

174. ________



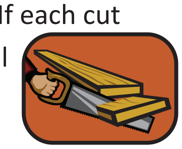
In the *xy*-coordinate plane, AB = 5, AC = 13, and lines BC and AB are perpendicular, as shown. The coordinates of point B are (−4, 0), and point A is on the *x*-axis. If the *y*-intercept of line CA has coordinates (0, *k*), what is the value of *k*? Express your answer as a decimal to the nearest tenth.

175. ________ The quadratic equation $x^2 - 7x + 5 = 0$ has two real roots, m and n. What is the value of $\frac{1}{m} + \frac{1}{n}$? Express your answer as a common fraction.

176. ________ To win a certain lottery, one must match three different numbers chosen from the integers 1 through 25, in any order. Liam buys 500 tickets, each with a unique combination of numbers. What is his probability of winning? Express your answer as a decimal to the nearest hundredth.

177. $ ________ Jayden buys two belts and four scarves for $59.70. Katrina buys three belts and five scarves for $80.60. Assuming that all belts cost the same and all scarves cost the same, what is the cost of one belt?

178. ________ inches A piece of wood is to be sawed into 15 smaller pieces, each 2 inches in length. If each cut eliminates $\frac{1}{8}$ inch of wood as sawdust, how many inches long must the original piece of wood be? Express your answer as a decimal to the nearest hundredth.



179. ________ penguins There are 190 penguins standing near the beach, and then one penguin dives into the sea, followed by two penguins, then three penguins, and so on, with one more penguin in each group. How many penguins will be in the last group?

180. ________ cm^2 A circle of radius 1 cm is inscribed in a square, as shown in Figure 1. In Figure 2, a circle of radius 1 cm circumscribes a square. What is the absolute difference between the shaded area in Figure 1 and the shaded area in Figure 2? Express your answer as a decimal to the nearest hundredth.

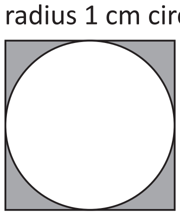


Figure 1

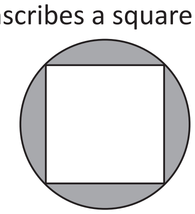


Figure 2

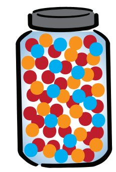
Warm-Up 13

181. ________ ordered pairs A bag contains eight red tags numbered from 1 to 8 and two blue tags numbered 9 and 10. If Sid selects two tags from the bag at random, with replacement, how many different ordered pairs of tags can he select with at least one red tag?

182. ________ While working with a drawing program, Rochelle changed the dimensions of a rectangle so that the new rectangle was $\frac{1}{2}$ as tall and $\frac{1}{4}$ as wide as the original rectangle. What is the ratio of the area of the new rectangle to the area of the original rectangle? Express your answer as a common fraction.

183. ________ The graph of a linear equation contains the points (1, a), (2, b) and (4, 18). What is the value of $\frac{3}{2}b - a$?

184. ________ marbles Sue, Kim and Donna each entered into a drawing to guess the number of marbles in a jar. Sue estimated 300, Kim estimated 325 and Donna estimated 360. One estimate was off by 49 marbles, another estimate was off by 24 marbles and the remaining estimate was off by 11 marbles. How many marbles are in the jar?



185. ________ A cylinder has height 9 inches and diameter 8 inches. The volume of the largest sphere that can fit in the cylinder is $\frac{\pi x}{3}$ in^3. What is the value of x?

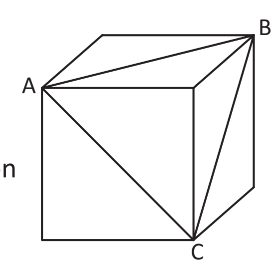
186. $ ________ Briana's retail store had a $1000 surplus last quarter, so she awarded employee bonuses. She divided the entire surplus among her sales team, which includes a sales manager, five full-time sales associates and four junior associates. Each junior associate received the same amount of money. Each full-time sales associate received twice as much as each junior associate. The sales manager received three times as much as each full-time sales associate. What was the amount of the sales manager's bonus?

187. ________ Given that $x^2 + 2xy + y^2 = 81$, $x > 0$ and $y > 0$, what is the mean of x and y? Express your answer as a decimal to the nearest tenth.

188. ________ What is the value of $1 - 5 \cdot 2 + 10 \cdot 2^2 - 10 \cdot 2^3 + 5 \cdot 2^4 - 2^5$?

189. ________ bricks Vincent is building a structure out of LEGO® bricks. The top level (first level) is a rectangle of 1 brick by 2 bricks. The level directly below the top level (second level) is a rectangle of 2 bricks by 3 bricks. The third level is a 3-by-4 rectangle. If the pattern continues, how many bricks are needed to build a structure 12 levels high?

190. ________ in^2 Vertices A, B and C of a cube are connected as shown. If the volume of the cube is 27 in^3, what is the area of $\triangle ABC$? Express your answer as a common fraction in simplest radical form.



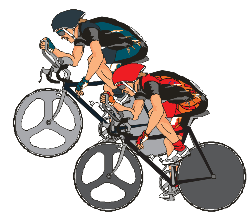
Warm-Up 14

191. __________ What is the units digit of $1! + 2! + 3! + \cdots + 2014!$?

192. ________ units^2 In a square of side length 12 units, what is the area of the region of points that are closer to the center of the square than to any vertex?

193. __________ The product of the integers from 1 through 10 is equal to $2^a \cdot 3^b \cdot 5^2 \cdot 7$, where a and b are positive integers. What is the value of $a + b$?

194. ________ km/h Ava and Lizzy were both competing in long-distance bike races. Ava's race was 150 km long, and Lizzy's race was 180 km long. They completed their races in the same time. If Lizzy's average rate was 2 km/h faster than Ava's, what was Ava's average rate?



195. __________ The product of the first three terms of an arithmetic sequence of integers is a prime number. What is the sum of the three numbers?

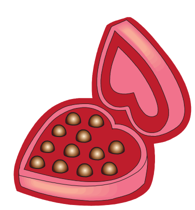
196. ________ feet A triangle has a base of 3 feet and a height of 6 feet. If its area is increased to 35 ft^2 by increasing the base and height by the same number of feet, what is the sum of the new base and height?

197. ________ lists How many lists of integers that contain only powers of 2 have a sum of 9, if the order within each list is not important and numbers can be repeated?

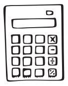
198. __________ Anthony took five tests in physics last semester, each with a maximum score of 100. Anthony's five integer test scores have a mean of 85, a median of 87 and a unique mode of 92. What is the lowest possible score Anthony could have for one of his five tests?

199. ________ marbles Sara told Jo, "If you give me three of your marbles, I will have twice as many as you." Jo responded, "If you give me just two of your marbles, I will have twice as many as you." How many marbles does Sara have?

200. __________ Angel opens a box containing a dozen chocolate-covered candies. Each candy has a vanilla, raspberry or lemon crème filling. Angel likes the vanilla candies, but she can't tell which candies have vanilla filling because the candies in the box look identical. If four of the candies have vanilla filling, and Angel randomly selects two candies from the box, what is the probability that both candies have vanilla filling? Express your answer as a common fraction.



Workout 7



201. $_______

Twenty of Ms. Oliver's math students each agreed to contribute the same amount of money toward the purchase of her retirement gift. The students would have had exactly enough for the gift they selected, but four students forgot to bring in their contributions. If each of the other students gives an additional \$1.50, they will still have exactly enough to purchase the gift that was selected. What is the total amount of money the students need to purchase the gift they selected for Ms. Oliver?

202. _______ When $\dfrac{(a^2b^{-3}c)^2(a^{-1}b^3c^3)^{-3}}{(a^{-1}b^3c^{-2})^2(a^4bc^{-3})^4}$ is rewritten as $a^xb^yc^z$, what is the value of $x + y + z$?

203. _______ miles The engineers at an auto manufacturer pay students \$0.08 per mile plus \$25 per day to road test their new vehicles. Archer earned \$48 on one day by road testing a new car. How far did he drive? Express your answer as a decimal to the nearest tenth.

204. _______ times In 1982, Albert Rayner skipped a rope 128 times in 10 seconds. If he could have continued at that rate, how many times would he have skipped the rope in 1 hour?

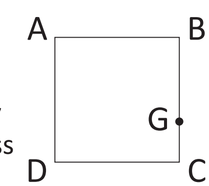
205. _______ If Andrew and Beth each randomly think of an integer from 1 to 10 inclusive, what is the probability that their numbers are relatively prime? Note: Every integer is relatively prime to 1. Express your answer as a common fraction.

206. _______ hours The number of *E. coli* bacteria in a rich medium is increasing at a rate of 50% every 3 hours. How many hours does it take for 960 bacteria to increase to 4860 bacteria?

207. _______ spheres A pile of clay can be molded to form a solid cube with edges that measure 10 cm. What is the maximum number of solid spheres of radius 2 cm that can be made from the same amount of clay?

208. _______ There are exactly $n!$ seconds in 6 weeks. What is the value of n?

209. _______ m² A goat is fastened by a rope to an exterior wall of a square building ABCD at point G, shown here. The distance from the goat's collar to the end of the rope fastened to the wall is 3 m. If G is 1 m from C and 2 m from B, how many square meters of the large yard surrounding ABCD can the goat cover? Express your answer to the nearest integer.



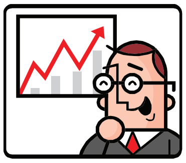
210. _______ For the integer 263, neither pair of consecutive digits (the pair 2 and 6 and the pair 6 and 3) is relatively prime. But the nonconsecutive digits 2 and 3 are relatively prime. What is the greatest positive integer n that satisfies the following three conditions?

(1) None of the digits is zero.
(2) No pair of consecutive digits is relatively prime.
(3) All non-consecutive digits are relatively prime.

Warm-Up 15

211. ________ hours A cylindrical tank starts with an unspecified amount of water in it, and water is added to it at a constant rate. After 8 hours the depth of the water in the tank is 34 feet. After 12 hours, the water depth is 35 feet. After how many hours in all will the water depth in the tank be 37 feet?

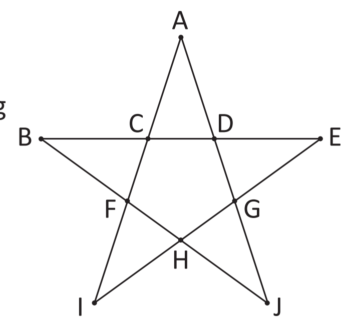
212. $ ________



The closing price of a stock on Tuesday was double its closing price on Monday. Its closing price on Wednesday was 3 times its closing price on Tuesday. Its closing price on Thursday was 10 times its closing price on Wednesday. Its closing price on Thursday was $72,000. What was its closing price on Monday?

213. ________ ft² In the Mexican jungle, an archaeologist finds a right square pyramid with a base edge length of 60 yards. The pyramid has lateral edge length 50 yards. In square feet, what is the total surface area of the lateral faces of the pyramid?

214. ________ arrange-ments The game board for Star Line-Up is shown. Players take turns placing markers on the lettered points. The first player to get three markers on the same line is the winner. For instance, a player would win for covering A, D and G or for covering A, D and J. How many winning arrangements of three markers are there?



215. ________ If $\dfrac{64^8}{32^{-3}} = 2^k$, what is the value of k?

216. ________ A wooden cube is painted on each of its faces and then cut into n^3 unit cubes. If 216 of those smaller cubes are painted on exactly one face, what is the value of n?

217. ________ Line m is tangent to a circle at the point (3, 7). If (1, 4) is the center of the circle, what is the slope of line m? Express your answer as a common fraction.

218. ________ If $f(x) = \begin{cases} \sqrt{x} & \text{if } x \geq 16 \\ x+1 & \text{if } 10 < x < 16 \\ \frac{x}{2} - 10 & \text{if } 0 \leq x \leq 10 \\ x^2 & \text{if } x < 0 \end{cases}$, what is the value of $f(f(f(f(f(f(f(f(f(f(f(f(13))))))))))))$?

219. ________ days

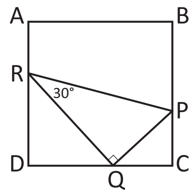
The *ides* occur on the 15th day of March, May, July and October, but the ides occur on the 13th day of every other month. What is the maximum number of days strictly between two ides?

220. ________ units There exist two non-congruent right triangles for which the length of the shorter leg in each triangle is 9 units and all sides have integer lengths. What is the sum of the lengths of the longer legs of these two triangles?

Warm-Up 16

221. ________ In the decimal representation of $\frac{1}{17} = 0.\overline{058m235294117647}$, what is the value of the digit m?

222. ________



Quadrilateral ABCD is a square. What is the ratio of the area of $\triangle PQC$ to the area of $\triangle RQD$? Express your answer as a common fraction.

223. ________ teams In a basketball league of n teams in which each team plays every other team twice, the total number of games played is $n^2 - n$. How many teams are in the league if 56 games were played?

224. ________ The odds against the Patriots playing in the championship game are 4:1. The odds against the Texans playing in the championship game are 7:1. What is the probability that those two teams will play each other in the championship game? Express your answer as a common fraction.

225. ________ ordered pairs How many ordered pairs of integers (x, y) satisfy $xy = 144$?

226. ________ yards A boat can hold three people, one of whom needs to row to cross a river that is 20 yards wide. What is the minimum distance the boat must travel to transport 9 people from the left bank of the river to the right bank?

227. ________ Point C(4, 2) is on circle O, with center (4, −2). Segment CD is a diameter of circle O. If circle O intersects the x-axis at A and B, what is the ratio of the length of $\overset{\frown}{ACB}$ to the length of $\overset{\frown}{ADB}$? Express your answer as a common fraction.

228. ________ On October 12, 2006, Michael Cresta scored 830 points in a game of Scrabble. At one point in the game, the letter R was on the board, and he had the letters I, O, Q, U and X on his rack. In the bag of tiles, there were 3 Ts, 1 Y and 52 other tiles. He needed to draw a T and a Y in two draws, without replacement, to have the letters to make the word QUIXOTRY. What is the probability of getting a T and a Y when 2 tiles are randomly selected, without replacement, from the bag of tiles described? Express your answer as a common fraction.

229. ________ gallons A 5-gallon and a 20-gallon jug can be used to measure exactly 5 gallons or 20 gallons of water, respectively. They can also be used to measure 15 gallons by filling the 20-gallon jug with water, dumping 5 gallons into the 5-gallon jug and having 15 gallons of water left in the 20-gallon jug. Using similar processes, what is the sum of all positive integer numbers of gallons that can be obtained using only the 5-gallon and the 20-gallon jugs?

230. ________ cars As a used-car salesperson, Noah has a monthly sales quota, which is the minimum number of cars he must sell each month. Noah had not sold any cars in June, as of the 24th of the month. However, on June 25th, Noah sold half of the number of cars in his monthly quota, plus one more car. On June 26th, he sold half of the remaining number of cars he needed to sell, plus one more car. The same pattern continued until June 30th, when Noah sold half of the remaining cars he needed to sell, plus one more car and reached his monthly sales quota. Noah has a monthly sales quota to sell how many cars?

Workout 8

231. ________ Given that 12, *v*, *w*, *x*, *y*, *z* is an arithmetic sequence whose median is 20.75, what is the sum of these six numbers? Express your answer as a decimal to the nearest tenth.

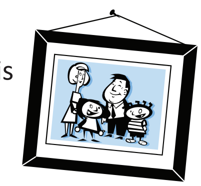
232. ________ ways In a beauty contest, 51 contestants must be narrowed down to a first-, second- and third-place finalist. In how many ways can the three finalists be chosen?

233. ________ minutes

A runner completes the first mile of a 26-mile race in 5 minutes. After that, each mile takes 1% longer than the previous mile. How many minutes does it take the runner to complete 26 miles? Express your answer to the nearest whole number.

234. ________ combinations In the land of Binaria, the currency consists of coins worth 1¢, 2¢, 4¢, 8¢, 16¢, 32¢ and 64¢. Bina has two of each coin. How many combinations of her coins have a combined value of 50¢?

235. ________ in^2 John has an 8-inch by 10-inch photo that he wants to shrink so that its perimeter is exactly 27 inches. After the photo has been reduced in size, what will be the area of the new photo?



236. ________ cm Each rectangle in a collection has a length 1 cm more than three times its width. What is the maximum possible width of one of these rectangles if its perimeter is less than or equal to 150 cm? Express your answer as a decimal to the nearest tenth.

237. ________ % If $x > 0$, then 2% of 5% of $3x$ equals what percent of x? Express your answer to the nearest tenth.

238. ________ ways

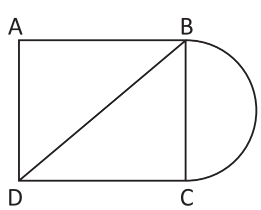
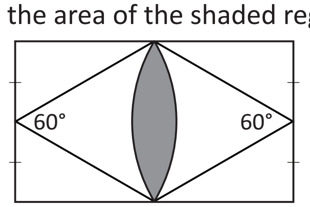


Figure ABCD can be drawn, without retracing, in one continuous pen stroke. If the stroke must begin at A, B, C or D, in how many different ways can this be done?

239. ________ units^2 A rectangle measures $2 \times 2\sqrt{3}$ units. Two arcs are drawn with their centers at the midpoints of the shorter sides, as shown. What is the area of the shaded region? Express your answer as a decimal to the nearest hundredth.



240. ________ % If four people each randomly pick an integer from 1 to 10, inclusive, what is the probability that at least two of the people pick the same integer? Express your answer to the nearest tenth.

Warm-Up 17

241. ________ students At one school, the ratio of students who have one or more younger siblings to those who have no younger siblings is 6 to 5. If 180 students do not have a younger sibling, how many students at this school have one or more younger siblings?

242. ________ inches A regular octagon has side length $2\sqrt{2}$ inches. What is the median length of all its diagonals? Express your answer in simplest radical form.

243. ________ Kevin and Evan have a set of 10 freshly inked stamps, one for each digit 0 through 9. When freshly inked, each stamp makes exactly 20 impressions. Kevin and Evan will stamp consecutive integers beginning with 1 and continuing until not enough ink remains to stamp the next consecutive number. What is the last number Kevin and Evan will be able to stamp?

244. ________ Each box in the expression below is to be filled in with one of the symbols +, −, × or ÷, with each symbol used exactly once. If no parentheses are inserted, what is the least possible absolute value of the resulting number? Express your answer as a decimal to the nearest tenth.

$$1 \square 2 \square 3 \square 4 \square 5$$

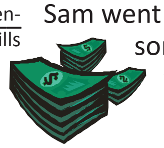
245. ________ units What is the greatest possible distance between some point on a square of side length 2 units and some point on its inscribed circle? Express your answer in simplest radical form.

246. ________ If $f(x) = x(x - 1)(x + 1)$, what is the product of the nonzero real numbers x such that $f(x) = x$?

247. ________ inches The integer sides of a triangle are in the ratio 3:4:6. If the perimeter of the triangle is 26 inches, what is the length of the longest side?

248. ________ seconds There is a moving sidewalk in the local shopping mall. When Marlow stands still on the moving sidewalk, it takes her 180 seconds to get from one end of the sidewalk to the other end. Walking beside the moving sidewalk at a constant rate, it takes Marlow 90 seconds to travel the same distance. If Marlow were to get on the sidewalk and walk at her same rate, in the same direction as the moving sidewalk, how many seconds would it take her to get from one end of the sidewalk to the other end?

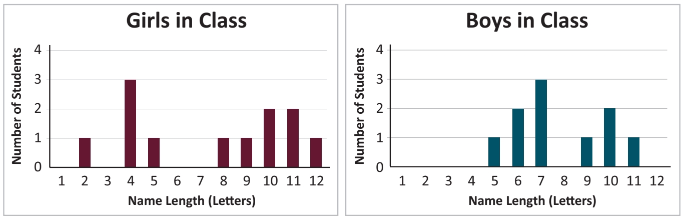
249. ________ ten-dollar bills Sam went to the bank to withdraw $440.00. He received 30 bills altogether. There were some five-, some ten- and some twenty-dollar bills. Sam received four times as many twenty-dollar bills as five-dollar bills. How many ten-dollar bills did Sam receive?



250. ________ Using the number keypad shown, it is possible to convert any three-digit number to various three-letter strings by choosing one letter for each number. For example, 223 can be used to make *BAD*, *ACE*, *CCF*, and 24 others, some of which are real words and some of which are not. Using only the buttons 2 through 9, what is the smallest three-digit number such that none of its possible three-letter strings are real words? (Exclude proper nouns and abbreviations.)

Warm-Up 18

251. __________ The bar charts below show the number of letters in the first names of the girls and boys in Mrs. Rodriguez's class. If one girl and one boy are chosen at random, what is the probability that the chosen students have the same number of letters in their first names? Express your answer as a common fraction.



252. ______ positive integers How many positive integers are in the domain of $f(x) = \dfrac{\sqrt{12 - x}}{4 - x^2}$?

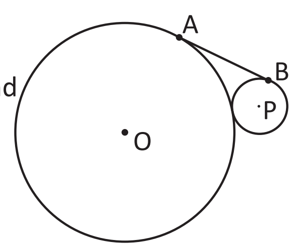
253. __________ Two standard six-sided dice are to be rolled. If the sum is an even number greater than 7, then what is the probability that both dice are even? Express your answer as a common fraction.

254. ______ units^3 A cylinder's radius is equal to its height. If its surface area is 100π units^2, what is its volume? Express your answer in terms of π.

255. __________ A number n is randomly chosen from the set {1, 2, 3, …, 24, 25}. What is the probability that the equation $x^2 + nx + 24 = 0$ has two integer solutions? Express your answer as a common fraction.

256. ___:___ a.m. Silas has a clock that gains 15 minutes each hour; for instance, if it shows the correct time at 2:00 p.m., one hour later it will show a time of 3:15 p.m. when it should show 3:00 p.m. Last night, Silas set the clock to the correct time at 10:00 p.m. While he was sleeping, the clock stopped working, and it showed a time of 4:00 a.m. That was 4 hours before he woke up. At what time did Silas wake up?

257. ______ cm Circle O and circle P are tangent to each other. Circle O has radius 8 cm and is tangent to segment AB at A, as shown. Circle P has radius 2 cm and is tangent to segment AB at B. What is the length of segment AB?



258. __________ The six integers 1, 3, 5, 7, 9 and 11 form an arithmetic sequence. If three of the integers are selected randomly without replacement, what is the probability that they form an arithmetic sequence in the order they are selected? Express your answer as a common fraction.

259. __________ The first three terms of an arithmetic sequence are p, 6 and $2p - 3$. What is the tenth term of this sequence?

260. __________ If RATS × 4 = STAR, and each letter represents a different digit from 0 to 9, inclusive, what is the value of S + T + A + R?

Workout 9

261. __________

Subtract →
↓

17	10	*7*
8	5	*3*
9	*5*	4

Figure 1

In Figure 1, numbers were subtracted vertically and horizontally until a value was found for the shaded box. For instance, 17 – 10 = 7 and 8 – 5 = 3 were the results from the first two rows, with 7 – 3 = 4 in the third column. If the partially completed grid in Figure 2 follows the same rules, what is the value of $m + n$?

Subtract →
↓

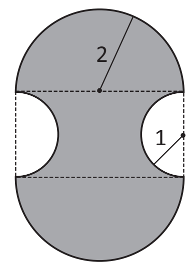
263	m	
n	34	
		104

Figure 2

262. __________ If $(a + b)^c = 1024$ for positive integers $a < b < c$, what is the value of b?

263. ______ seconds The time, t seconds, that it takes for a rock to fall a distance, d meters, is approximately $t = 0.45\sqrt{d}$. How many seconds does it take a rock to fall 200 m? Express your answer as a decimal to the nearest tenth.

264. ______ units^2 Congruent semicircles are placed on the top and bottom of a rectangle (dotted segments), and congruent semicircles are removed from the left and right sides of the rectangle, as shown. How many square units are in the area of the shaded figure? Express your answer as a decimal to the nearest hundredth.

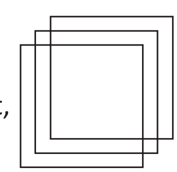


265. ______ in^2 An ice cream cone is 5 inches tall with a radius of 1.5 inches. The outer surface area of the cone is covered with chocolate. How many square inches of cone are covered with chocolate? Express your answer as a decimal to the nearest tenth.

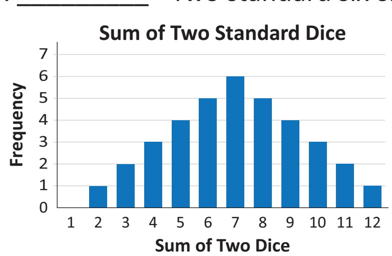
266. __________ In Bag A are 9 red balls and 1 green ball. A player gets one draw from Bag A and wins if the green ball is selected. In Bag B are 99 red balls and 1 green ball. A player gets 20 draws from Bag B and wins if the green ball is selected, but if the selected ball is red, it must be returned to the bag before the next draw. What is the absolute difference between the probability of winning with Bag A and the probability of winning with Bag B? Express your answer as a decimal to the nearest thousandth.

267. ______ elements How many elements are in the set $\{x^2 - 2x + 1 \mid x = -5, -4, \ldots, 4, 5\}$?

268. ______ regions When three squares are arranged as shown, seven unique regions are formed. What is the maximum number of regions that can be formed by three congruent, overlapping squares?



269. __________ Two standard six-sided dice, each with faces numbered with the positive integers 1 through 6, have the probability distribution shown for the sum of the top-facing values on the dice. Two non-standard but fair six-sided dice can be numbered differently with nonnegative integers on each face and still yield the same probability distribution. Though a number may be on both dice, a number may not appear more than once on either die. If a is the sum of the six numbers on one of these non-standard dice, and b is the sum of the six numbers on the other die, what is the value of the product $a \times b$?



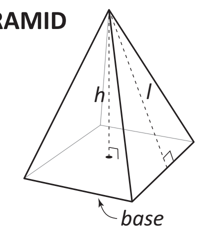
270. __________ The digits 2, 0, 1 and 4 are used to create every possible positive four-digit integer, with each digit used exactly once in each integer. What is the arithmetic mean of all these integers?

Surface Area & Volume Stretch

This activity involves determining the surface area (SA) and volume (V) of various geometric solids. For the purposes of these exercises, all solids are assumed to be right (the height is perpendicular to the base at its center). Below is an example of each solid along with the formulas for determing its surface area and volume.

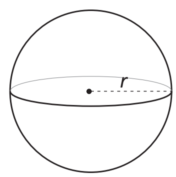
B = base area P = base perimeter h = height l = slant height r = radius

PYRAMID



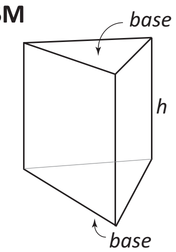
SA = $B + \frac{1}{2}Pl$
V = $\frac{1}{3}Bh$

SPHERE



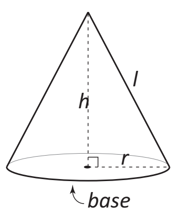
SA = $4\pi r^2$
V = $\frac{4}{3}\pi r^3$

PRISM



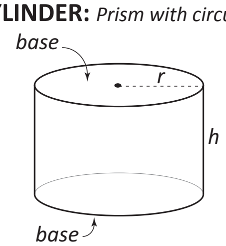
SA = $2B + Ph$
V = Bh

CONE: *Pyramid with circular base*



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

CYLINDER: *Prism with circular bases*



SA = $2\pi r^2 + 2\pi rh$
V = $\pi r^2 h$

For 271 and 272, find the surface area and volume of the geometric solid.

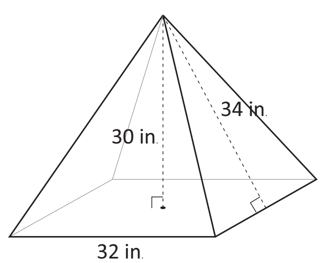
271. SA = ____________ in^2

V = ____________ in^3

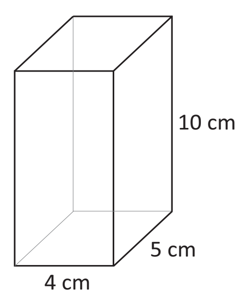
272. SA = ____________ cm^2

V = ____________ cm^3

271. square pyramid



272. rectangular prism



For 273-275, find the surface area and volume of the geometric solid. Express your answer in terms of π.

273. SA = ____________ m^2

V = ____________ m^3

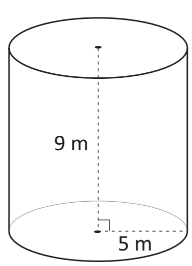
274. SA = ____________ cm^2

V = ____________ cm^3

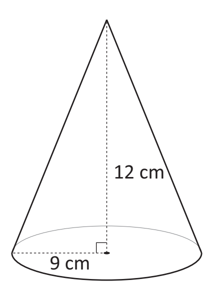
275. SA = ____________ ft^2

V = ____________ ft^3

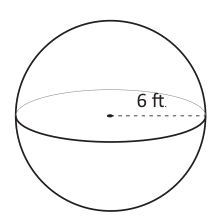
273. cylinder



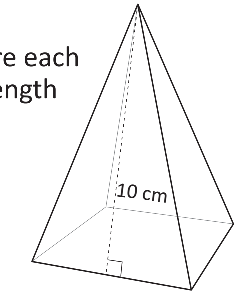
274. cone



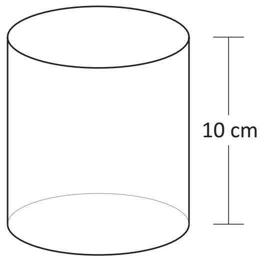
275. sphere



276. ____________ cm A right square pyramid has lateral faces with slant heights that are each 10 cm. If the surface area of this pyramid is 96 cm^2, what is the length of one of the edges of the base?

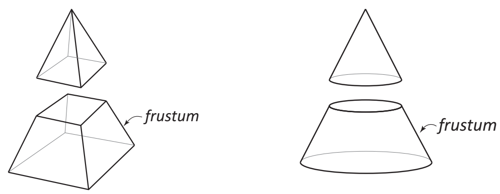


277. ____________ cm^2

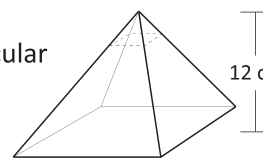


What is the surface area, in square centimeters, of a cylinder with volume 250π cm^3 and height 10 cm? Express your answer in terms of π.

The frustum of a cone or a pyramid is that part of the solid left when the top portion is cut off by a plane parallel to its base.



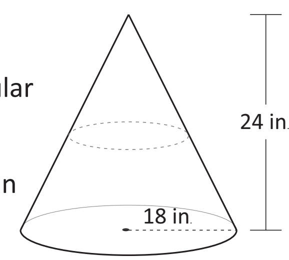
278. A pyramid with height 12 cm has a square base with area 64 cm^2. A plane perpendicular to the height intersects the pyramid 3 cm from its apex.



a. ____________ cm^3 What is the volume of the resulting frustum?

b. ____________ cm^2 What is the surface area of the frustum? Express your answer in simplest radical form.

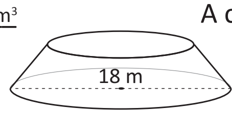
279. A cone with a height of 24 inches has a base with radius 18 inches. A plane perpendicular to the height intersects the cone halfway between its apex and base.



a. ____________ in^3 What is the volume of the resulting frustum? Express your answer in terms of π.

b. ____________ in^2 What is the surface area of the frustum? Express your answer in terms of π.

280. ____________ m^3

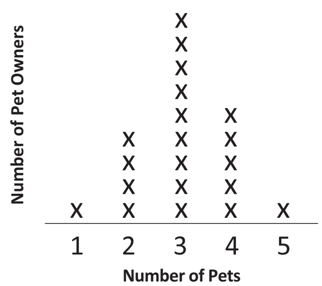


A cone of height 9 m was cut parallel to its base at 3 m above its base. If the base of the original cone had diameter 18 m, what is the volume of the resulting frustum? Express your answer in terms of π.

Data & Statistics Stretch

281. ________ pets As part of a survey, 20 pet owners indicated the total number of pets they currently own, and the results are displayed in the line plot shown. What is the mean of the median and the mode of the data?

Total Number of Pets per Owner



282. ________ mi/h The maximum speed of the fastest roller coaster at 20 different amusement parks is shown in this stem-and-leaf plot, where 10|7 represents 107 mi/h. What is the absolute difference between the mean and the median of the data? Express your answer as a decimal to the nearest tenth.

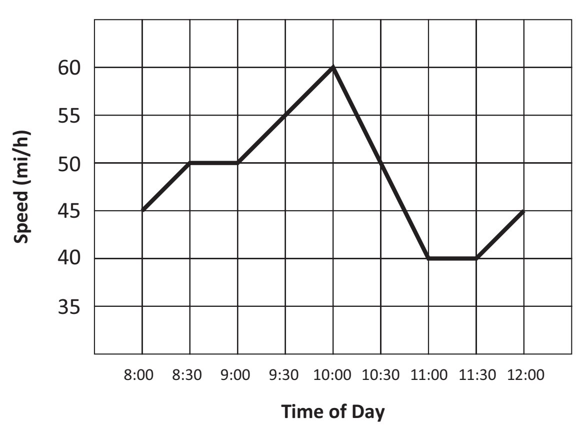
Maximum Speed of 20 Roller Coasters (mi/h)

Stem	Leaf				
9	0	2	3	5	6
10	0	0	7		
11	6	9			
12	0	8			
13	0	5	6	9	
14	1	3	8		
15	0				

283. ________ mi/h The line graph shows one driver's speed, in miles per hour, from 8:00 a.m. to 12:00 noon. Based on the graph, what was the driver's average speed from 10:30 to 11:30? Express your answer as a decimal to the nearest tenth.

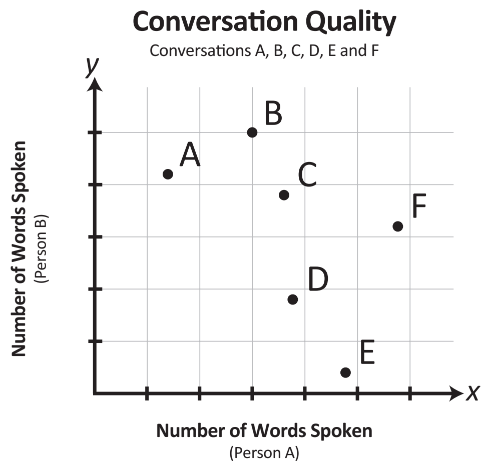
Driver's Speed

8:00 a.m. to 12:00 noon



284. point

The quality of a conversation between two people can be described by the ratio of the number of words spoken by each person. The closer the ratio is to 1, the higher the quality. Each point in the graph shown represents a two-person conversation, with the number of words spoken by one person on the *x*-axis and the number of words spoken by the other person on the *y*-axis. If both axes use the same scale, which point in the graph represents the conversation with the highest quality?



285. __________ If the mean of five values is 27, what is the sum of the five values?

286. __________ When each of five numbers is doubled, the mean of the five new numbers is 60. What was the mean of the five original numbers?

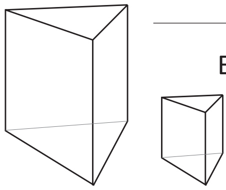
287. __________ A list of 20 numbers has a mean of 37. When two numbers are removed from the list, the new mean is 38. What is the mean of the two numbers that were removed?

288. __________ The mean, median and unique mode of six positive integers are 8, 7 and 3, respectively. What is the maximum possible value for the range of the six numbers?

289. __________ The mean of three consecutive terms in an arithmetic sequence is 10, and the mean of their squares is 394. What is the largest of the three original terms?

290. __________ Six different positive integers add to 66. If one of them is the mean and another is the range, what is the largest possible number in the set?

Geometric Proportions Stretch

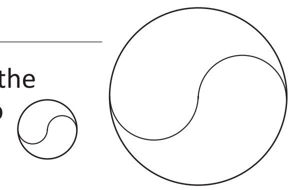


291. __________ smaller prisms

Each edge of the smaller triangular prism shown is $\frac{1}{2}$ the corresponding edge length of the larger triangular prism. How many of the smaller prisms combined have a total volume equal to the volume of the larger prism?

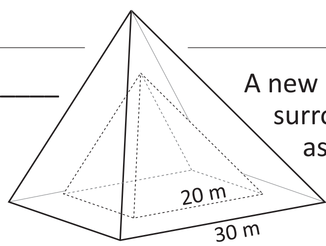
292. __________ A plane, parallel to the bases, slices the smaller prism $\frac{3}{4}$ of the way from one base to the other, dividing it into two smaller prisms. Of the three prisms, what fraction of the volume of the largest prism is the volume of the smallest prism? Express your answer as a common fraction.

293. __________ For the two similar circles shown, the area of the large circle is nine times the area of the small circle. What is the ratio of the radius of the small circle to the radius of the large circle? Express your answer as a common fraction.



294. __________ cm If the S-curve in the large circle has length 3.12 cm, what is the length of the S-curve in the small circle? Express your answer as a decimal to the nearest hundredth.

295. __________

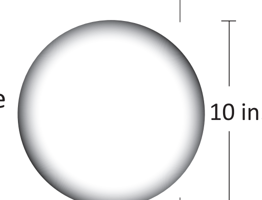


A new solid pyramid with a square base of side length 30 m will be constructed surrounding an existing solid pyramid with a square base of side length 20 m, as shown. If the existing and new pyramids are similar, what is the ratio of the total volume of the new pyramid to the volume of the old pyramid? Express your answer as a common fraction.

296. __________ years It took 16 years to completely build the original pyramid. Adding to the original pyramid, at the same volume-per-year rate, in how many years will construction of the new, larger pyramid be completed?

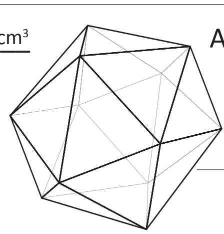
297. __________ in^3 A glassblower starts with a solid glass sphere that is 2 inches in diameter. What is the volume of the glass sphere? Express your answer as a decimal to the nearest hundredth.

298. __________ The glassblower will heat the glass sphere and blow air into it to create a hollow sphere 10 inches in diameter of uniform thickness. What is the ratio between the surface area of the original sphere and that of the new, hollow sphere? Express your answer as a common fraction.



299. __________ In the finished hollow sphere, what is the ratio of the volume of glass to the volume of enclosed air? Express your answer as a common fraction.

300. __________ cm^3



An icosahedron sculpture is being installed at a state fair. On the architect's model of the sculpture, each of the 20 equilateral triangular faces has area 2.85 cm^2. The actual sculpture has a total surface area of 4617 cm^2. If the volume of the model is 34 cm^3, what is the volume of the actual sculpture?

BUILDING A COMPETITION PROGRAM

RECRUITING MATHLETES®

Ideally, the materials in this handbook will be incorporated into the regular classroom curriculum so that all students learn problem-solving techniques and develop critical thinking skills. When the meetings of a school's MATHCOUNTS team or club are limited to extracurricular sessions, all interested students should be invited to participate regardless of their academic standing. Because the greatest benefits of the MATHCOUNTS programs are realized at the school level, the more Mathletes involved, the better. Students should view their experience with MATHCOUNTS as fun, as well as challenging, so let them know from the very first meeting that the goal is to have a good time while learning.

Here are some suggestions from successful competition coaches and club leaders on how to stimulate interest at the beginning of the school year:

- Build a display case showing MATHCOUNTS shirts and posters. Include trophies and photos from previous years' club sessions or competitions.
- Post intriguing math questions (involving specific school activities and situations) in hallways, the library and the cafeteria. Refer students to the first meeting for answers.
- Make a presentation at the first pep rally or student assembly.
- Approach students through other extracurricular clubs (e.g., honor society, science club, chess club).
- Inform parents of the benefits of MATHCOUNTS participation via the school newsletter or PTA.
- Create a MATHCOUNTS display for Back-to-School Night.
- Have former Mathletes speak to students about the rewards of the program.
- Incorporate the Problem of the Week from the MATHCOUNTS website (www.mathcounts.org/potw) into the weekly class schedule.

MAINTAINING A STRONG PROGRAM

Keep the school program strong by soliciting local support and focusing attention on the rewards of MATHCOUNTS. Publicize success stories. Let the rest of the student body see how much fun Mathletes have. Remember, the more this year's students get from the experience, the easier recruiting will be next year. Here are some suggestions:

- Publicize MATHCOUNTS meetings and events in the school newspaper and local media.
- Inform parents of meetings and events through the PTA, open houses and the school newsletter.
- Schedule a special pep rally for the Mathletes.
- Recognize the achievements of club members at a school awards program.
- Have a students-versus-teachers Countdown Round, and invite the student body to watch.
- Solicit donations from local businesses to be used as prizes in practice competitions.
- Plan retreats or field trips for the Mathletes to area college campuses or hold an annual reunion.
- Take photos at club meetings, coaching sessions or competitions and keep a scrapbook.
- Distribute MATHCOUNTS shirts to participating students.
- Start a MATHCOUNTS summer-school program.
- Encourage teachers of students in lower grades to participate in mathematics enrichment programs.

MATHCOUNTS® COMPETITION SERIES EST. 1983

A MORE DETAILED LOOK

The MATHCOUNTS Foundation administers its math enrichment, coaching and competition program with a grassroots network of more than 17,000 volunteers who organize MATHCOUNTS competitions nationwide. Each year more than 500 local competitions and 56 "state" competitions are conducted, primarily by chapter and state societies of the National Society of Professional Engineers. All 50 states, the District of Columbia, Puerto Rico, Guam, Virgin Islands, U.S. Department of Defense schools and U.S. State Department schools worldwide participate in MATHCOUNTS. Here's everything you need to know to get involved.

PREPARATION MATERIALS

The annual *MATHCOUNTS School Handbook* provides the basis for coaches and volunteers to coach student Mathletes on problem-solving and mathematical skills. Coaches are encouraged to make maximum use of MATHCOUNTS materials by incorporating them into their classrooms or by using them with extracurricular math clubs. Coaches also are encouraged to share this material with other teachers at their schools, as well as with parents.

The *2013–2014 MATHCOUNTS School Handbook* contains 300 problems. As always, these FREE, challenging and creative problems have been written to meet the National Council of Teachers of Mathematics' Standards for grades 6-8. The link for the *School Handbook* is being sent electronically to every U.S. school with 7th- and/or 8th-grade students and to any other school that registered for the MATHCOUNTS Competition Series last year. This handbook also is available to schools with 6th-grade students. A hard copy of the *MATHCOUNTS School Handbook* is available upon request to all schools, free of charge. Coaches who register for the MATHCOUNTS Competition Series will receive the handbook in their School Competition Kit.

In addition to the great math problems, be sure to take advantage of the following resources that are included in the *2013-2014 MATHCOUNTS School Handbook*:

Vocabulary and Formulas are listed on pages 52-53.
A **Problem Index** is provided on pages 82-83 to assist you in incorporating the *MATHCOUNTS School Handbook* problems into your curriculum. This index organizes the problems by topic, difficulty rating and mapping to the Common Core State Standard for each problem.
Difficulty Ratings on a scale of 1-7, with 7 being the most difficult, are explained on page 54.
Common Core State Standards are explained on page 81.

A variety of additional information and resources can be found on the MATHCOUNTS website, at www.mathcounts.org, including problems and answers from the previous year's Chapter and State Competitions, the MATHCOUNTS Coaching Kit, The National Math Club resources and links to state programs. When you register for either the Competition Series or The National Math Club (and you have created a User Profile on the website), you will receive access to even more free resources that are not visible or available to the general public. Be sure to create a User Profile as soon as possible, and then visit the Coaches section of the site.

The MATHCOUNTS OPLET, which contains *MATHCOUNTS School Handbook* problems and competition problems from the last 13 years, is a wonderful resource. Once a 12-month subscription is purchased, the user can create customized worksheets, flash cards and Problems of the Day by using this database of problems. For more information, see page 8 or go to www.mathcounts.org/oplet and check out some screen shots of the MATHCOUNTS OPLET. A 12-month subscription can be purchased online.

Additional coaching materials and novelty items may be ordered through Sports Awards. An order form, with information on the full range of products, is available in the MATHCOUNTS Store section at www.mathcounts.org/store or by calling Sports Awards toll-free at 800-621-5803. A limited selection of MATHCOUNTS materials also is available at www.artofproblemsolving.com.

COACHING STUDENTS

The coaching season begins at the start of the school year. The sooner you begin your coaching sessions, the more likely students still will have room in their schedules for your meetings and the more preparation they can receive before the competitions.

The original problems found in the *MATHCOUNTS School Handbook* are divided into three sections: Warm-Ups, Workouts and Stretches. Each Warm-Up and Workout contains problems that generally survey the grades 6-8 mathematics curricula. Workouts assume the use of a calculator; Warm-Ups do not. The Stretches are collections of problems centered around a specific topic.

The problems are designed to provide Mathletes with a large variety of challenges and prepare them for the MATHCOUNTS competitions. (These materials also may be used as the basis for an exciting extracurricular mathematics club or may simply supplement the normal middle school mathematics curriculum.)
Answers to all problems in the handbook include codes indicating level of difficulty and Common Core State Standard. The difficulty ratings are explained on page 54, and the Common Core State Standards are explained on page 81.

WARM-UPS AND WORKOUTS

The Warm-Ups and Workouts are on pages 9-35 and are designed to increase in difficulty as students go through the handbook.

For use in the classroom, Warm-Ups and Workouts serve as excellent additional practice for the mathematics that students already are learning. In preparation for competition, the Warm-Ups can be used to prepare students for problems they will encounter in the Sprint Round. It is assumed that students will not be using calculators for Warm-Up problems. The Workouts can be used to prepare students for the Target and Team Rounds of competition. It is assumed that students will be using calculators for Workout problems.
All of the problems provide students with practice in a variety of problem-solving situations and may be used to diagnose skill levels, to practice and apply skills or to evaluate growth in skills.

STRETCHES

Pages 36-40 present the Surface Area and Volume, Data and Statistics, and Geometric Proportions Stretches. The problems cover a variety of difficulty levels. These Stretches may be incorporated in your students' practice at any time.

ANSWERS

Answers to all problems can be found on pages 54-58.

SOLUTIONS

Compete solutions for the problems start on page 59. These are only possible solutions. You or your students may come up with more elegant solutions.

SCHEDULE

The Stretches can be used at any time. The following chart is the recommended schedule for using the Warm-Ups and Workouts if you are participating in the Competition Series.

September 2013	Warm-Ups 1-2	Workout 1
October	Warm-Ups 3-6	Workouts 2-3
November	Warm-Ups 7-10	Workouts 4-5
December	Warm-Ups 11-14	Workouts 6-7
January 2014	Warm-Ups 15-16	Workout 8
	MATHCOUNTS School Competition	
	Warm-Ups 17-18	Workout 9
February	Selection of competitors for Chapter Competition	
	MATHCOUNTS Chapter Competition	

To encourage participation by the greatest number of students, postpone selection of your school's official competitors until just before the local competition.

On average, MATHCOUNTS coaches meet with Mathletes for an hour one or two times a week at the beginning of the year and with increasing frequency as the competitions approach. Sessions may be held before school, during lunch, after school, on weekends or at other times, coordinating with your school's schedule and avoiding conflicts with other activities.

Here are some suggestions for getting the most out of the Warm-Ups and Workouts at coaching sessions:

- Encourage discussion of the problems so that students learn from one another.
- Encourage a variety of methods for solving problems.
- Have students write problems for each other.
- Use the MATHCOUNTS Problem of the Week. Currently, this set of problems is posted every Monday on the MATHCOUNTS website at www.mathcounts.org/potw.
- Practice working in groups to develop teamwork (and to prepare for the Team Round).
- Practice oral presentations to reinforce understanding.
- Take advantage of additional MATHCOUNTS coaching materials, such as previous years' competitions, to provide an extra challenge or to prepare for competition.
- Provide refreshments and vary the location of your meetings to create a relaxing, enjoyable atmosphere.
- Invite the school principal to a session to offer words of support.
- Recruit volunteers. Volunteer assistance can be used to enrich the program and expand it to more students. Fellow teachers can serve as assistant coaches. Individuals such as MATHCOUNTS alumni and high school students, parents, community professionals and retirees also can help.

OFFICIAL RULES AND PROCEDURES

The following rules and procedures govern all MATHCOUNTS competitions. The MATHCOUNTS Foundation reserves the right to alter these rules and procedures at any time. **Coaches are responsible for being familiar with the rules and procedures outlined in this handbook.** Coaches should bring any difficulty in procedures or in student conduct to the immediate attention of the appropriate chapter, state or national official. Students violating any rules may be subject to immediate disqualification.

REGISTRATION

For your school to participate in the MATHCOUNTS Competition Series, a school representative is required to complete and return the Competition Series Registration Form (available at www.mathcounts.org/competitionreg) along with a check, money order, purchase order or credit card authorization. **Your registration must be postmarked no later than December 13, 2013** and mailed to MATHCOUNTS Registration, P.O. Box 441, Annapolis Junction, MD 20701. Registration forms also may be scanned and submitted via e-mail at reg@mathcounts.org or faxed to 240-396-5602. *For early bird registrations postmarked by November 15, 2013, the discounted cost to register a team is $90, and the discounted cost to register each individual is $25*. For registrations postmarked after November 15, 2013 but by December 13, 2013, the cost to register a team is $100, and the cost to register each individual is $30. Schools entitled to receive Title I funds may register for half the cost of the applicable registration fee. An additional fee of $20 will be assessed to process late registrations. (This fee is for each late registration form and not for each student being registered.)

Please note that submission of your Competition Series Registration Form will not register your school for The National Math Club. In order to register for The National Math Club and receive your Club in a Box, please complete and return a National Math Club Registration Form, available at the back of this handbook or on our website at www.mathcounts.org/clubreg.

By completing the Competition Series Registration Form, the coach attests to the school administration's permission to register students for MATHCOUNTS.

Academic centers or enrichment programs that do not function as students' official school of record are not eligible to register.

Registration in the Competition Series entitles a school to send students to the local competition and receive the School Competition Kit (which includes the *2013-2014 School Handbook*, recognition ribbons, student participation certificates and a catalog of additional coaching materials) and an e-mailed copy of the School Competition (with instructions, problems and answers). Mailings of the School Competition Kits will occur on a rolling basis through December 31, 2013.

Your Registration Form must be postmarked by December 13, 2013. *In some circumstances, late registrations might be accepted, at the discretion of MATHCOUNTS and the local coordinator.* However, late fees will apply.

The sooner you register, the sooner you will receive your School Competition Kit to help prepare your team. Once processed, confirmation of your registration will be available at www.mathcounts.org/competitionschools. Other questions about the status of your registration should be directed to MATHCOUNTS Registration, P.O. Box 441, Annapolis Junction, MD 20701. Telephone: 301-498-6141. Your state or local coordinator will be notified of your registration, and you then will be informed of the date and location of your local competition. **If you have not been contacted by mid-January with competition details, it is your responsibility to contact your local coordinator** to confirm that your registration has been properly routed and that your school's participation is expected. Coordinator contact information is available at www.mathcounts.org/competition.

ELIGIBLE PARTICIPANTS

Students enrolled in the 6th, 7th or 8th grade are eligible to participate in MATHCOUNTS competitions. Students taking middle school mathematics classes who are not full-time 6th, 7th or 8th graders are not eligible. Participation in MATHCOUNTS competitions is limited to three years for each student, though there is no limit to the number of years a student may participate in the school-based coaching phase.

School Registration: A school may register one team of four and up to six individuals for a total of 10 participants. You must designate team members versus individuals prior to the start of the Chapter (local) Competition (i.e., a student registered as an "individual" may not help his or her school team advance to the next level of competition).

Team Registration: Only one team (of up to four students) per school is eligible to compete. Members of a school team will participate in the Sprint, Target and Team Rounds. Members of a school team also will be eligible to qualify for the Countdown Round (where conducted). Team members will be eligible for team awards, individual awards and progression to the state and national levels based on their individual and/or team performance. It is recommended that your strongest four Mathletes form your school team. Teams of fewer than four will be allowed to compete; however, the team score will be computed by dividing the sum of the team members' scores by 4 (see "Scoring" on page 49 for details). Consequently, teams of fewer than four students will be at a disadvantage.

Individual Registration: Up to six students may be registered in addition to or in lieu of a school team. Students registered as individuals will participate in the Sprint and Target Rounds but not the Team Round. Individuals will be eligible to qualify for the Countdown Round (where conducted). Individuals also will be eligible for individual awards and progression to the state and national levels.

School Definitions: *Academic centers or enrichment programs that do not function as students' official school of record are not eligible to register.* If it is unclear whether an educational institution is considered a school, please contact your local Department of Education for specific criteria governing your state.

School Enrollment Status: *A student may compete only for his or her official school of record.* A student's school of record is the student's base or main school. A student taking limited course work at a second school or educational center may not register or compete for that second school or center, even if the student is not competing for his or her school of record. MATHCOUNTS registration is not determined by where a student takes his or her math course. If there is any doubt about a student's school of record, the local or state coordinator must be contacted for a decision before registering.

Small Schools: MATHCOUNTS does not distinguish between the sizes of schools for Competition Series registration and competition purposes. Every "brick-and-mortar" school will have the same registration allowance of up to one team of four students and/or up to six individuals. A school's participants may not combine with any other school's participants to form a team when registering or competing.

Homeschools: Homeschools in compliance with the homeschool laws of the state in which they are located are eligible to participate in MATHCOUNTS competitions in accordance with all other rules. Homeschool coaches must complete a Homeschool Participation Attestation Form, verifying that students from the homeschool or homeschool group are in the 6th, 7th or 8th grade and that each homeschool complies with applicable state laws. Completed attestations must be submitted to the national office before registrations will be processed. A Homeschool Participation Attestation Form can be downloaded from www.mathcounts.org/competition. Please fax attestations to 703-299-5009.

Virtual Schools: Any virtual school interested in registering students must contact the MATHCOUNTS national office at 703-299-9006 before December 13, 2013 for registration details. Any student registering as a virtual school student must compete in the MATHCOUNTS Chapter Competition assigned according to the student's home address. Additionally, virtual school coaches must complete a Homeschool Participation Attestation Form verifying that the students from the virtual school are in the 6th, 7th or 8th grade and that the virtual school complies with applicable state laws. Completed attestations must be submitted to the national office before registrations will be processed. A Homeschool Participation Attestation Form can be downloaded from www.mathcounts.org/competition. Please fax attestations to 703-299-5009.

Substitutions by Coaches: Coaches may not substitute team members for the State Competition unless a student voluntarily releases his or her position on the school team. Additional requirements and documentation for substitutions (such as requiring parental release or requiring the substitution request to be submitted in writing) are at the discretion of the state coordinator. Coaches may not make substitutions for students progressing to the State Competition as individuals. At all levels of competition, student substitutions are not permitted after on-site competition registration has been completed. A student being added to a team need not be a student who was registered for the Chapter Competition as an individual.

Religious Observances: A student who is unable to attend a competition due to religious observances may take the written portion of the competition up to one week in advance of the scheduled competition. In addition, all competitors from that student's school must take the exam at the same time. ***Advance testing will be done at the discretion of the local and state coordinators. If advance testing is deemed possible, it will be conducted under proctored conditions.*** If the student who is unable to attend the competition due to a religious observance is not part of the school team, then the team has the option of taking the Team Round during this advance testing or on the regularly scheduled day of the competition with the other teams. The coordinator must be made aware of the team's decision before the advance testing takes place. Students who qualify for an official Countdown Round but are unable to attend will automatically forfeit one place standing.

Special Needs: Reasonable accommodations may be made to allow students with special needs to participate. ***A request for accommodation of special needs must be directed to local or state coordinators in writing at least three weeks in advance of the local or state competition.*** This written request should thoroughly explain a student's special need as well as what the desired accommodation would entail. Many accommodations that are employed in a classroom or teaching environment cannot be implemented in the competition setting. Accommodations that are not permissible include, but are not limited to, granting a student extra time during any of the competition rounds or allowing a student to use a calculator for the Sprint or Countdown Rounds. In conjunction with the MATHCOUNTS Foundation, coordinators will review the needs of the student and determine if any accommodations will be made. In making final determinations, the feasibility of accommodating these needs at the National Competition will be taken into consideration.

LEVELS OF COMPETITION

MATHCOUNTS competitions are organized at four levels: school, chapter (local), state and national. Competition questions are written for the 6th- through 8th-grade audience. The competitions can be quite challenging, particularly for students who have not been coached using MATHCOUNTS materials. All competition materials are prepared by the national office.

The real success of MATHCOUNTS is influenced by the coaching sessions at the school level. This component of the program involves the most students (more than 500,000 annually), comprises the longest period of time and demands the greatest involvement.

SCHOOL COMPETITION: In January, after several months of coaching, schools registered for the Competition Series should administer the School Competition to all interested students. The School Competition is intended to be an aid to the coach in determining competitors for the Chapter (local) Competition. *Selection of team and individual competitors is entirely at the discretion of coaches and need not be based solely on School Competition scores.* School Competition material is sent to the coach of a school, and it may be used by the teachers and students only in association with that school's programs and activities. The current year's School Competition questions must remain confidential and may not be used in outside activities, such as tutoring sessions or enrichment programs with students from other schools. *For additional announcements or edits, please check the Coaches section on the MATHCOUNTS website before administering the School Competition.*

It is important that the coach look upon coaching sessions during the academic year as opportunities to develop better math skills in all students, not just in those students who will be competing. Therefore, it is suggested that the coach postpone selection of competitors until just prior to the local competitions.

CHAPTER COMPETITIONS: Held from February 1 through February 28, 2014, the Chapter Competition consists of the Sprint, Target and Team Rounds. The Countdown Round (official or just for fun) may or may not be included. The chapter and state coordinators determine the date and administration of the Chapter (local) Competition in accordance with established national procedures and rules. Winning teams and students will receive recognition. The winning team will advance to the State Competition. Additionally, the two highest-ranking competitors not on the winning team (who may be registered as individuals or as members of a team) will advance to the State Competition. This is a minimum of six advancing Mathletes (assuming the winning team has four members). Additional teams and/or Mathletes also may progress at the discretion of the state coordinator. The policy for progression must be consistent for all chapters within a state.

STATE COMPETITIONS: Held from March 1 through March 31, 2014, the State Competition consists of the Sprint, Target and Team Rounds. The Countdown Round (official or just for fun) may or may not be included. The state coordinator determines the date and administration of the State Competition in accordance with established national procedures and rules. Winning teams and students will receive recognition. The four highest-ranked Mathletes and the coach of the winning team from each State Competition will receive an all-expenses-paid trip to the National Competition.

RAYTHEON MATHCOUNTS NATIONAL COMPETITION: Held Friday, May 9, 2014 in Orlando, Florida, the National Competition consists of the Sprint, Target, Team and Countdown Rounds. Expenses of the state team and coach to travel to the National Competition will be paid by MATHCOUNTS. The national program does not make provisions for the attendance of additional students or coaches. All national competitors will receive a plaque and other items in recognition of their achievements. Winning teams and individuals also will receive medals, trophies and college scholarships.

COMPETITION COMPONENTS

MATHCOUNTS competitions are designed to be completed in approximately three hours:

The **SPRINT ROUND** (40 minutes) consists of 30 problems. This round tests accuracy, with the time period allowing only the most capable students to complete all of the problems. **Calculators are not permitted.**

The **TARGET ROUND** (approximately 30 minutes) consists of 8 problems presented to competitors in four pairs (6 minutes per pair). This round features multistep problems that engage Mathletes in mathematical reasoning and problem-solving processes. **Problems assume the use of calculators.**

The **TEAM ROUND** (20 minutes) consists of 10 problems that team members work together to solve. Team member interaction is permitted and encouraged. **Problems assume the use of calculators.**
<u>Note</u>: Coordinators may opt to allow those competing as individuals to create a "squad" to take the Team Round for the experience, but the round *should not be scored and is not considered official.*

The **COUNTDOWN ROUND** is a fast-paced oral competition for top-scoring individuals (based on scores in the Sprint and Target Rounds). In this round, pairs of Mathletes compete against each other and the clock to solve problems. **Calculators are not permitted.**

At Chapter and State Competitions, a Countdown Round may be conducted officially or unofficially (for fun) or it may be omitted. However, the use of an official Countdown Round must be consistent for all chapters within a state. In other words, *all* chapters within a state must use the round officially in order for *any* chapter within a state to use it officially. All students, whether registered as part of a school team or as individual competitors, are eligible to qualify for the Countdown Round.

An *official* Countdown Round is defined as one that determines an individual's final overall rank in the competition. If the Countdown Round is used officially, the official procedures as established by the MATHCOUNTS Foundation must be followed.

If a Countdown Round is conducted *unofficially*, the official procedures do not have to be followed. Chapters and states choosing not to conduct the round officially must determine individual winners on the sole basis of students' scores in the Sprint and Target Rounds of the competition.

In an official Countdown Round, the top 25% of students, up to a maximum of 10, are selected to compete. These students are chosen based on their individual scores. The two lowest-ranked students are paired, a question is projected and students are given 45 seconds to solve the problem. A student may buzz in at any time, and if he or she answers correctly, a point is scored; if a student answers incorrectly, the other student has the remainder of the 45 seconds to answer. Three questions are read to the pair of students, one question at a time, and the student who scores the higher number of points (not necessarily 2 out of 3) captures the place, progresses to the next round and challenges the next-higher-ranked student. (If students are tied after three questions (at 1-1 or 0-0), questions continue to be read until one is successfully answered.) This procedure continues until the fourth-ranked Mathlete and his or her opponent compete. For the final four rounds, the first student to correctly answer three questions advances. The Countdown Round proceeds until a first-place individual is identified. (More detailed rules regarding the Countdown Round procedure are identified in the Instructions section of the School Competition Booklet.) *Note: Rules for the Countdown Round change for the National Competition.*

ADDITIONAL RULES

All answers must be legible.

Pencils and paper will be provided for Mathletes by competition organizers. However, students may bring their own pencils, pens and erasers if they wish. They may not use their own scratch paper or graph paper.

Use of notes or other reference materials (including dictionaries and translation dictionaries) is not permitted.

Specific instructions stated in a given problem take precedence over any general rule or procedure.

Communication with coaches is prohibited during rounds but is permitted during breaks. All communication between guests and Mathletes is prohibited during competition rounds. Communication between teammates is permitted only during the Team Round.

Calculators are not permitted in the Sprint and Countdown Rounds, but they are permitted in the Target, Team and Tiebreaker (if needed) Rounds. When calculators are permitted, students may use any calculator (including programmable and graphing calculators) that does not contain a QWERTY (typewriter-like) keypad. Calculators that have the ability to enter letters of the alphabet but do not have a keypad in a standard typewriter arrangement are acceptable. Smart phones, laptops, iPads®, iPods®, personal digital assistants (PDAs), and any other "smart" devices are not considered to be calculators and may not be used during competitions. Students may not use calculators to exchange information with another person or device during the competition.

Coaches are responsible for ensuring that their students use acceptable calculators, and students are responsible for providing their own calculators. Coordinators are not responsible for providing Mathletes with calculators or batteries before or during MATHCOUNTS competitions. Coaches are strongly advised to bring backup calculators and spare batteries to the competition for their team members in case of a malfunctioning calculator or weak or dead batteries. Neither the MATHCOUNTS Foundation nor coordinators shall be responsible for the consequences of a calculator's malfunctioning.

Pagers, cell phones, iPods® and other MP3 players should not be brought into the competition room. Failure to comply could result in dismissal from the competition.

Should there be a rule violation or suspicion of irregularities, the MATHCOUNTS coordinator or competition official has the obligation and authority to exercise his or her judgment regarding the situation and take appropriate action, which might include disqualification of the suspected student(s) from the competition.

SCORING

Competition scores do not conform to traditional grading scales. **Coaches and students should view an individual written competition score of 23 (out of a possible 46) as highly commendable.**

The individual score is the sum of the number of Sprint Round questions answered correctly and twice the number of Target Round questions answered correctly. There are 30 questions in the Sprint Round and 8 questions in the Target Round, so the maximum possible individual score is 30 + 2(8) = 46.

The team score is calculated by dividing the sum of the team members' individual scores by 4 (even if the team has fewer than four members) and adding twice the number of Team Round questions answered correctly. The highest possible individual score is 46. Four students may compete on a team, and there are 10 questions in the Team Round. Therefore, the maximum possible team score is ((46 + 46 + 46 + 46) ÷ 4) + 2(10) = 66.

If used officially, the Countdown Round yields final individual standings.

Ties will be broken as necessary to determine team and individual prizes and to determine which individuals qualify for the Countdown Round. For ties between individuals, the student with the higher Sprint Round score will receive the higher rank. If a tie remains after this comparison, specific groups of questions from the Sprint and Target Rounds are compared. For ties between teams, the team with the higher Team Round score, and then the higher sum of the team members' Sprint Round scores, receives the higher rank. If a tie remains after these comparisons, specific questions from the Team Round will be compared. *Note*: These are very general guidelines. Competition officials receive more detailed procedures.

In general, questions in the Sprint, Target and Team Rounds increase in difficulty so that the most difficult questions occur near the end of each round. In a comparison of questions to break ties, generally those who correctly answer the more difficult questions receive the higher rank.

RESULTS DISTRIBUTION

Coaches should expect to receive the scores of their students and a list of the top 25% of students and top 40% of teams from their coordinators. In addition, single copies of the blank competition materials and answer keys may be distributed to coaches after all competitions at that level nationwide have been completed. ***Before distributing blank competition materials and answer keys, coordinators must wait for verification from the national office that all such competitions have been completed.*** Both the problems and answers from Chapter and State Competitions will be posted on the MATHCOUNTS website following the completion of all competitions at that level nationwide (Chapter - early March; State - early April). The previous year's problems and answers will be taken off the website at that time.

Student competition papers and answers will not be viewed by or distributed to coaches, parents, students or other individuals. Students' competition papers become the confidential property of the MATHCOUNTS Foundation.

FORMS OF ANSWERS

The following rules explain acceptable forms for answers. Coaches should ensure that Mathletes are familiar with these rules prior to participating at any level of competition. Judges will score competition answers in compliance with these rules for forms of answers.

All answers must be expressed in simplest form. A "common fraction" is to be considered a fraction in the form $\pm\frac{a}{b}$, where a and b are natural numbers and GCF(a, b) = 1. In some cases the term "common fraction" is to be considered a fraction in the form $\frac{A}{B}$, where A and B are algebraic expressions and A and B do not have a common factor. A simplified "mixed number" ("mixed numeral," "mixed fraction") is to be considered a fraction in the form $\pm N\frac{a}{b}$, where N, a and b are natural numbers, $a < b$ and GCF(a, b) = 1. Examples:

Problem: Express 8 divided by 12 as a common fraction. *Answer:* $\frac{2}{3}$ *Unacceptable:* $\frac{4}{6}$

Problem: Express 12 divided by 8 as a common fraction. *Answer:* $\frac{3}{2}$ *Unacceptable:* $\frac{12}{8}$, $1\frac{1}{2}$

Problem: Express the sum of the lengths of the radius and the circumference of a circle with a diameter of $\frac{1}{4}$ as a common fraction in terms of π. *Answer:* $\frac{1+2\pi}{8}$

Problem: Express 20 divided by 12 as a mixed number. *Answer:* $1\frac{2}{3}$ *Unacceptable:* $1\frac{8}{12}$, $\frac{5}{3}$

Ratios should be expressed as simplified common fractions unless otherwise specified. Examples:
Simplified, Acceptable Forms: $\frac{7}{2}$, $\frac{3}{\pi}$, $\frac{4-\pi}{6}$ *Unacceptable:* $3\frac{1}{2}$, $\frac{\frac{1}{4}}{3}$, 3.5, 2:1

Radicals must be simplified. A simplified radical must satisfy: 1) no radicands have a factor which possesses the root indicated by the index; 2) no radicands contain fractions; and 3) no radicals appear in the denominator of a fraction. Numbers with fractional exponents are *not* in radical form. Examples:
Problem: Evaluate $\sqrt{15} \times \sqrt{5}$. *Answer:* $5\sqrt{3}$ *Unacceptable:* $\sqrt{75}$

Answers to problems asking for a response in the form of a dollar amount or an unspecified monetary unit (e.g., "How many dollars...," "How much will it cost...," "What is the amount of interest...") should be expressed in the form ($) *a.bc*, where *a* is an integer and *b* and *c* are digits. The *only* exceptions to this rule are when a is zero, in which case it may be omitted, or when b and c are both zero, in which case they may both be omitted. Examples:
Acceptable: 2.35, 0.38, .38, 5.00, 5 *Unacceptable:* 4.9, 8.0

Units of measurement are not required in answers, but they must be correct if given. When a problem asks for an answer expressed in a specific unit of measure or when a unit of measure is provided in the answer blank, equivalent answers expressed in other units are not acceptable. For example, if a problem asks for the number of ounces and 36 oz is the correct answer, 2 lb 4 oz will not be accepted. If a problem asks for the number of cents and 25 cents is the correct answer, $0.25 will not be accepted.

Do not make approximations for numbers (e.g., π, $\frac{2}{3}$, $5\sqrt{3}$) in the data given or in solutions unless the problem says to do so.

Do not do any intermediate rounding (other than the "rounding" a calculator performs) when calculating solutions. All rounding should be done at the end of the calculation process.

Scientific notation should be expressed in the form $a \times 10^n$ where a is a decimal, $1 \leq |a| < 10$, and n is an integer. Examples:
Problem: Write 6895 in scientific notation. *Answer:* 6.895×10^3
Problem: Write 40,000 in scientific notation. *Answer:* 4×10^4 *or* 4.0×10^4

An answer expressed to a greater or lesser degree of accuracy than called for in the problem will not be accepted. Whole-number answers should be expressed in their whole-number form.
Thus, 25.0 will not be accepted for 25, and 25 will not be accepted for 25.0.

The plural form of the units will always be provided in the answer blank, even if the answer appears to require the singular form of the units.

VOCABULARY AND FORMULAS

The following list is representative of terminology used in the problems but should not be viewed as all-inclusive. It is recommended that coaches review this list with their Mathletes.

absolute difference
absolute value
acute angle
additive inverse (opposite)
adjacent angles
algorithm
alternate exterior angles
alternate interior angles
altitude (height)
apex
area
arithmetic mean
arithmetic sequence
base 10
binary
bisect
box-and-whisker plot
center
chord
circle
circumference
circumscribe
coefficient
collinear
combination
common denominator
common divisor
common factor
common fraction
common multiple
complementary angles
composite number
compound interest
concentric
cone
congruent
convex
coordinate plane/system
coordinates of a point
coplanar
corresponding angles
counting numbers
counting principle
cube
cylinder
decagon
decimal
degree measure
denominator
diagonal of a polygon
diagonal of a polyhedron
diameter
difference
digit
digit-sum
direct variation
dividend
divisible
divisor
dodecagon
dodecahedron
domain of a function
edge
endpoint
equation
equiangular
equidistant
equilateral
evaluate
expected value
exponent
expression
exterior angle of a polygon
factor
factorial
finite
formula
frequency distribution
frustum
function
GCF
geometric mean
geometric sequence
height (altitude)
hemisphere
heptagon
hexagon
hypotenuse
image(s) of a point (points) (under a transformation)
improper fraction
inequality
infinite series
inscribe
integer
interior angle of a polygon
interquartile range
intersection
inverse variation
irrational number
isosceles
lateral edge
lateral surface area
lattice point(s)
LCM
linear equation
mean
median of a set of data
median of a triangle
midpoint
mixed number
mode(s) of a set of data
multiple
multiplicative inverse (reciprocal)
natural number
nonagon
numerator
obtuse angle
octagon
octahedron
odds (probability)
opposite of a number (additive inverse)
ordered pair
origin
palindrome
parallel
parallelogram
Pascal’s Triangle
pentagon
percent increase/decrease
perimeter
permutation
perpendicular
planar
polygon
polyhedron
prime factorization

prime number
principal square root
prism
probability
product
proper divisor
proper factor
proper fraction
proportion
pyramid
Pythagorean Triple
quadrant
quadrilateral
quotient
radius
random
range of a data set
range of a function
rate
ratio
rational number
ray
real number
reciprocal (multiplicative inverse)
rectangle
reflection
regular polygon
relatively prime
remainder
repeating decimal
revolution
rhombus
right angle
right circular cone
right circular cylinder
right polyhedron
right triangle
rotation
scalene triangle
scientific notation
sector
segment of a circle
segment of a line
semicircle
sequence
set
significant digits
similar figures
simple interest
slope
slope-intercept form
solution set
sphere
square
square root
stem-and-leaf plot
sum
supplementary angles
system of equations/inequalities
tangent figures
tangent line
term
terminating decimal
tetrahedron
total surface area
transformation
translation
trapezoid
triangle
triangular numbers
trisect
twin primes
union
unit fraction
variable
vertex
vertical angles
volume
whole number
x-axis
x-coordinate
x-intercept
y-axis
y-coordinate
y-intercept

The list of formulas below is representative of those needed to solve MATHCOUNTS problems but should not be viewed as the only formulas that may be used. Many other formulas that are useful in problem solving should be discovered and derived by Mathletes.

CIRCUMFERENCE

Circle	$C = 2 \times \pi \times r = \pi \times d$

AREA

Circle	$A = \pi \times r^2$
Square	$A = s^2$
Rectangle	$A = l \times w = b \times h$
Parallelogram	$A = b \times h$
Trapezoid	$A = \frac{1}{2}(b_1 + b_2) \times h$
Rhombus	$A = \frac{1}{2} \times d_1 \times d_2$
Triangle	$A = \frac{1}{2} \times b \times h$
Triangle	$A = \sqrt{s(s-a)(s-b)(s-c)}$
Equilateral triangle	$A = \dfrac{s^2\sqrt{3}}{4}$

SURFACE AREA AND VOLUME

Sphere	$SA = 4 \times \pi \times r^2$
Sphere	$V = \frac{4}{3} \times \pi \times r^3$
Rectangular prism	$V = l \times w \times h$
Circular cylinder	$V = \pi \times r^2 \times h$
Circular cone	$V = \frac{1}{3} \times \pi \times r^2 \times h$
Pyramid	$V = \frac{1}{3} \times B \times h$

Pythagorean Theorem	$c^2 = a^2 + b^2$
Counting/ Combinations	${}_nC_r = \dfrac{n!}{r!(n-r)!}$

ANSWERS

In addition to the answer, we have provided a difficulty rating for each problem. Our scale is 1-7, with 7 being the most difficult. These are only approximations, and how difficult a problem is for a particular student will vary. Below is a general guide to the ratings:

Difficulty 1/2/3 - One concept; one- to two-step solution; appropriate for students just starting the middle school curriculum.

4/5 - One or two concepts; multistep solution; knowledge of some middle school topics is necessary.

6/7 - Multiple and/or advanced concepts; multistep solution; knowledge of advanced middle school topics and/or problem-solving strategies is necessary.

Warm-Up 1

Answer	Difficulty		
1. 5	(1)	6. 12	(3)
2. 8	(2)	7. 9/20	(4)
3. 8	(2)	8. 78	(4)
4. 6:38	(2)	9. 0.05	(3)
5. 1.75	(2)	10. August	(1)

Warm-Up 2

Answer	Difficulty		
11. 11	(2)	16. 666,666	(2)
12. 24	(2)	17. 4/3	(4)
13. 3	(3)	18. May	(3)
14. March	(2)	19. 36	(3)
15. 2	(2)	20. 66	(4)

Workout 1

Answer	Difficulty		
21. 1.5	(1)	26. 270	(2)
22. 2.72	(2)	27. $\sqrt{119}$	(4)
23. $4\sqrt{3}$	(5)	28. 5.57	(4)
24. 77.40	(3)	29. 1/4	(3)
25. 10	(3)	30. 16,865	(3)

Warm-Up 3

Answer	Difficulty		
31. 14/3	(2)	36. 3/4	(2)
32. 3/4	(2)	37. 6	(4)
33. 97	(3)	38. 1/6	(3)
34. 64	(4)	39. 7	(3)
35. 11/9	(4)	40. 32	(4)

Warm-Up 4

Answer	Difficulty		
41. −8	(3)	46. 1*	(3)
42. 36	(3)	47. 15	(3)
43. 65,000	(2)	48. 9	(4)
44. 1	(2)	49. 1/27	(4)
45. 235	(4)	50. $18x$	(2)

Workout 2

Answer	Difficulty		
51. −7	(4)	56. 41	(5)
52. 4	(3)	57. 24	(2)
53. 0	(3)	58. 84	(4)
54. 10	(3)	59. 144	(4)
55. 1.6	(5)	60. $16 + 16\sqrt{3}$ or $16\sqrt{3} + 16$	(4)

** The plural form of the units is always provided in the answer blank, even if the answer appears to require the singular form of the units.*

Warm-Up 5

Answer	Difficulty		
61. 45	(3)	66. 9	(4)
62. 8	(3)	67. 62	(4)
63. 2:00	(2)	68. 13	(3)
64. 10	(3)	69. 18	(5)
65. 2/3	(3)	70. 1/10	(5)

Warm-Up 6

Answer	Difficulty		
71. 2	(4)	76. −1	(4)
72. (−6, −12)	(4)	77. 30	(4)
73. 120	(3)	78. 4800 or 4800.00	(3)
74. 9	(3)	79. 27	(3)
75. 1/4	(4)	80. 134	(2)

Workout 3

Answer	Difficulty		
81. 281.32	(4)	86. 40,431	(3)
82. 2.25	(4)	87. (165π)/2	(3)
83. 1320	(4)	88. 22	(4)
84. 0.82	(4)	89. 3/4	(3)
85. 297.44	(3)	90. 67.88	(4)

Warm-Up 7

Answer	Difficulty		
91. 6	(2)	96. 6	(3)
92. 8/9	(4)	97. $9\frac{11}{12}$	(3)
93. 1/24	(4)	98. 1/6	(4)
94. 7/4	(3)	99. 800	(4)
95. 7	(3)	100. 8000	(4)

Warm-Up 8

Answer	Difficulty		
101. 17	(2)	106. 8	(3)
102. 36	(4)	107. $3x/10$	(4)
103. 5/4	(4)	108. 110	(5)
104. $2\frac{2}{3}$	(4)	109. 122	(4)
105. 7	(2)	110. 6	(4)

Workout 4

Answer	Difficulty		
111. 203.45	(3)	116. 63	(4)
112. 3	(3)	117. 329	(3)
113. 299	(6)	118. 11.56	(3)
114. 3.02	(6)	119. 400	(4)
115. 123.50	(3)	120. 75.4	(4)

Warm-Up 9

Answer	Difficulty		
121. 1925	(3)	126. 11	(3)
122. 300	(2)	127. 20	(4)
123. 6	(5)	128. (4, 3)	(5)
124. 10 or 10.00	(4)	129. 5	(4)
125. 77	(5)	130. 2	(4)

Warm-Up 10

Answer	Difficulty		
131. 5/9	(5)	136. 2.8×10^{-8}	(3)
132. 5	(3)	137. 130	(4)
133. 80	(4)	138. 10	(3)
134. 8	(3)	139. 8	(5)
135. 3	(3)	140. 12	(5)

Workout 5

Answer	Difficulty		
141. 12	(4)	146. 20	(3)
142. 48	(4)	147. 38.40	(3)
143. 32	(3)	148. 58.8	(3)
144. 88.5	(4)	149. 2	(4)
145. 11.25	(3)	150. 15	(4)

Warm-Up 11

Answer	Difficulty		
151. 18	(2)	156. 54	(3)
152. 2	(3)	157. 1/9	(4)
153. 4/19	(3)	158. $48 + 24\sqrt{2}$ or $24\sqrt{2} + 48$	(4)
154. 75	(3)	159. 30	(4)
155. 75	(4)	160. 42	(5)

Warm-Up 12

Answer	Difficulty		
161. 2000	(3)	166. 36π	(5)
162. 3	(4)	167. Elias	(5)
163. 6	(3)	168. 0	(4)
164. 4845	(4)	169. 7	(6)
165. 8	(3)	170. 20	(5)

Workout 6

Answer	Difficulty		
171. 1.6	(2)	176. 0.22	(5)
172. 237.5	(4)	177. 11.95	(4)
173. 21.3	(4)	178. 31.75	(3)
174. 21.6	(5)	179. 19	(3)
175. 7/5	(5)	180. 0.28	(5)

Warm-Up 13

Answer	Difficulty		
181. 96	(3)	186. 300 or 300.00	(4)
182. 1/8	(2)	187. 4.5	(5)
183. 9	(4)	188. −1	(2)
184. 349	(3)	189. 728	(4)
185. 256	(4)	190. $(9\sqrt{3})/2$	(4)

Warm-Up 14

Answer	Difficulty		
191. 3	(4)	196. 17	(4)
192. 72	(4)	197. 10	(4)
193. 12	(3)	198. 68	(3)
194. 10	(4)	199. 7	(3)
195. −3	(4)	200. 1/11	(3)

Workout 7

Answer	Difficulty		
201. 120 or 120.00	(3)	206. 12	(4)
202. −23	(4)	207. 29	(3)
203. 287.5	(3)	208. 10	(3)
204. 46,080	(2)	209. 18	(5)
205. 63/100	(5)	210. 968	(5)

Warm-Up 15

Answer	Difficulty		
211. 20	(3)	216. 8	(5)
212. 1200 or 1200.00	(2)	217. −2/3	(5)
213. 43,200	(4)	218. 7	(4)
214. 20	(4)	219. 31	(4)
215. 63	(4)	220. 52	(6)

Warm-Up 16

Answer	Difficulty		
221. 8	(2)	226. 140	(3)
222. 1/3	(5)	227. 1/2	(5)
223. 8	(3)	228. 3/1540	(5)
224. 1/40	(5)	229. 75	(4)
225. 30	(4)	230. 126	(6)

Workout 8

Answer	Difficulty		
231. 124.5	(5)	236. 18.5	(4)
232. 124,950	(4)	237. 0.3	(3)
233. 148	(5)	238. 32	(4)
234. 12	(4)	239. 0.72	(7)
235. 45	(4)	240. 49.6	(6)

Warm-Up 17

Answer	Difficulty		
241. 216	(2)	246. −2	(5)
242. $4 + 2\sqrt{2}$ or $2\sqrt{2} + 4$	(5)	247. 12	(3)
243. 99	(4)	248. 60	(5)
244. 0.2	(5)	249. 10	(4)
245. $1 + \sqrt{2}$ or $\sqrt{2} + 1$	(5)	250. 225	(4)

Warm-Up 18

Answer	Difficulty		
251. 1/15	(4)	256. 6:48	(5)
252. 11	(4)	257. 8	(6)
253. 2/3	(4)	258. 1/10	(5)
254. 125π	(4)	259. 14	(4)
255. 4/25	(4)	260. 18	(4)

Workout 9

Answer	Difficulty		
261. 193	(4)	266. 0.082	(5)
262. 3	(4)	267. 7	(3)
263. 6.4	(2)	268. 25	(5)
264. 17.42	(4)	269. 405	(7)
265. 24.6	(4)	270. 2506	(6)

Surface Area & Volume Stretch

Answer	Difficulty		
271. SA = 3200, V = 10,240	(3)	276. 4	(5)
272. SA = 220, V = 200	(3)	277. 150π	(5)
273. SA = 140π, V = 225π	(3)	278a. 252; b. $68 + 60\sqrt{10}$ or $60\sqrt{10} + 68$	(5)
274. SA = 216π, V = 324π	(3)	279a. 2268π; b. 810π	(5)
275. SA = 144π, V = 288π	(3)	280. 171π	(5)

Data & Statistics Stretch

Answer	Difficulty		
281. 3	(3)	286. 30	(3)
282. 0.6	(4)	287. 28	(4)
283. 42.5	(4)	288. 17	(5)
284. C	(3)	289. 31	(6)
285. 135	(3)	290. 25	(5)

Geometric Proportions Stretch

Answer	Difficulty		
291. 8	(4)	296. 38	(4)
292. 1/32	(4)	297. 4.19	(3)
293. 1/3	(4)	298. 1/25	(4)
294. 1.04	(3)	299. 1/124	(5)
295. 27/8	(4)	300. 24,786	(6)

MATHCOUNTS Problems Mapped to Common Core State Standards (CCSS)

Currently, 45 states have adopted the Common Core State Standards (CCSS). Because of this, MATHCOUNTS has concluded that it would be beneficial to teachers to see the connections between the CCSS and the *2013-2014 MATHCOUNTS School Handbook* problems. MATHCOUNTS not only has identified a general topic and assigned a difficulty level for each problem but also has provided a CCSS code in the Problem Index (pages 82-83). A complete list of the Common Core State Standards can be found at www.corestandards.org.

The CCSS for mathematics cover K-8 and high school courses. MATHCOUNTS problems are written to align with the NCTM Standards for Grades 6-8. As one would expect, there is great overlap between the two sets of standards. MATHCOUNTS also recognizes that in many school districts, algebra and geometry are taught in middle school, so some MATHCOUNTS problems also require skills taught in those courses.

In referring to the CCSS, the Problem Index code for each or the Standards for Mathematical Content for grades K-8 begins with the grade level. For the Standards for Mathematical Content for high school courses (such as algebra or geometry), each code begins with a letter to indicate the course name. The second part of each code indicates the domain within the grade level or course. Finally, the number of the individual standard within that domain follows. Here are two examples:

- *6.RP.3 → Standard #3 in the Ratios and Proportional Relationships domain of grade 6*
- *G-SRT.6 → Standard #6 in the Similarity, Right Triangles and Trigonometry domain of Geometry*

Some math concepts utilized in MATHCOUNTS problems are not specifically mentioned in the CCSS. Two examples are the Fundamental Counting Principle (FCP) and special right triangles. In cases like these, if a related standard could be identified, a code for that standard was used. For example, problems using the FCP were coded 7.SP.8, S-CP.8 or S-CP.9 depending on the context of the problem; SP → Statistics and Probability (the domain), S → Statistics and Probability (the course) and CP → Conditional Probability and the Rules of Probability. Problems based on special right triangles were given the code G-SRT.5 or G-SRT.6, explained above.

There are some MATHCOUNTS problems that either are based on math concepts outside the scope of the CCSS or based on concepts in the standards for grades K-5 but are obviously more difficult than a grade K-5 problem. When appropriate, these problems were given the code SMP for Standards for Mathematical Practice. The CCSS include the Standards for Mathematical Practice along with the Standards for Mathematical Content. The SMPs are (1) Make sense of problems and persevere in solving them; (2) Reason abstractly and quantitatively; (3) Construct viable arguments and critique the reasoning of others; (4) Model with mathematics; (5) Use appropriate tools strategically; (6) Attend to precision; (7) Look for and make use of structure and (8) Look for and express regularity in repeated reasoning.

PROBLEM INDEX

It is difficult to categorize many of the problems in the *MATHCOUNTS School Handbook*. It is very common for a MATHCOUNTS problem to straddle multiple categories and cover several concepts. This index is intended to be a helpful resource, but since each problem has been placed in exactly one category and mapped to exactly one Common Core State Standard (CCSS), the index is not perfect. In this index, the code **9 (3) 7.SP.3** refers to problem 9 with difficulty rating 3 mapped to CCSS 7.SP.3. For an explanation of the difficulty ratings refer to page 54. For an explanation of the CCSS codes refer to page 81.

Algebraic Expressions & Equations

6	(3)	8.EE.8
13	(3)	A-REI.4
36	(2)	6.EE.9
45	(4)	A-REI.2
54	(3)	N-RN.1
62	(3)	7.RP.2
64	(3)	6.EE.9
71	(4)	N-RN.1
77	(4)	A-SSE.2
82	(4)	8.EE.8
96	(3)	F-IF.1
99	(4)	8.EE.8
107	(4)	6.EE.7
112	(3)	8.EE.8
119	(4)	7.EE.4
129	(4)	SMP
134	(3)	6.EE.9
139	(5)	8.EE.8
150	(4)	8.EE.8
154	(3)	6.RP.1
159	(4)	4.MD.2
162	(4)	6.EE.1
169	(6)	8.EE.2
175	(5)	A-SSE.3
177	(4)	8.EE.8
186	(4)	6.EE.7
187	(5)	A-REI.4
188	(2)	A-APR.5
196	(4)	A-REI.4
199	(3)	8.EE.8
202	(4)	8.EE.1
215	(4)	8.EE.1
223	(3)	A-REI.4
246	(5)	F-IF.8
252	(4)	F-IF.5

General Math

3	(2)	7.NS.2
5	(2)	3.NBT.2
12	(2)	7.NS.1
26	(2)	4.MD.2
39	(3)	4.MD.2
53	(3)	7.RP.1
57	(2)	5.OA.1
63	(2)	4.MD.2
138	(3)	7.NS.3
201	(3)	7.NS.3
212	(2)	7.NS.3
219	(4)	SMP
263	(2)	4.MD.2
267	(3)	6.EE.2

Number Theory

11	(2)	SMP
16	(2)	4.OA.5
22	(2)	8.NS.1
25	(3)	SMP
42	(3)	4.OA.2
47	(3)	7.NS.1
59	(4)	SMP
66	(4)	SMP
70	(5)	SMP
80	(2)	SMP
91	(2)	SMP
101	(2)	7.NS.3
103	(4)	A-CED.1
136	(3)	8.EE.4
157	(4)	7.SP.7
165	(3)	4.OA.4
191	(4)	7.SP.8
193	(3)	4.0A.4
197	(4)	4.OA.4
208	(3)	4.OA.4
210	(5)	SMP
221	(2)	7.NS.2
225	(4)	4.OA.4
232	(4)	S-CP.9
234	(4)	SMP
244	(5)	3.NBT.2
249	(4)	8.EE.8
260	(4)	SMP
261	(4)	7.NS.1
262	(4)	8.EE.1

Problem Solving (Misc.)

4	(2)	4.MD.2
14	(2)	SMP
18	(3)	SMP
43	(2)	6.NS.1
97	(3)	SMP
109	(4)	SMP
113	(6)	SMP
116	(4)	7.NS.3
124	(4)	8.EE.8
127	(4)	SMP
132	(3)	SMP
156	(3)	6.RP.3
203	(3)	7.NS.3
229	(4)	SMP
230	(6)	7.NS.3
238	(4)	SMP

Statistics

10	(1)	6.SP.4
33	(3)	SMP
44	(2)	6.SP.2
56	(5)	6.SP.5
61	(3)	6.SP.2
73	(3)	6.RP.3
74	(3)	SMP
114	(6)	6.SP.5
149	(4)	6.SP.2
151	(2)	6.SP.5
198	(3)	6.SP.5
270	(6)	6.SP.5
281	(3)	6.SP.2
282	(4)	6.SP.2
283	(4)	6.SP.5
284	(3)	8.F.4
285	(3)	6.SP.2
286	(3)	6.SP.2
287	(4)	6.SP.5
288	(5)	6.SP.2
290	(5)	6.SP.2

Probability, Counting & Combinatorics

9	(3)	7.SP.5
29	(3)	7.SP.7
32	(2)	7.SP.7
38	(3)	7.SP.7
49	(4)	S-CP.1
75	(4)	S-CP.9
84	(4)	S-CP.8
93	(4)	S-CP.9
102	(4)	S-CP.9
126	(3)	SMP
133	(4)	SMP
141	(4)	S-CP.9
176	(5)	S-CP.9
181	(3)	SMP
200	(3)	7.SP.8
205	(5)	SMP
214	(4)	S-CP.9
218	(4)	7.SP.5
224	(5)	S-CP.8
228	(5)	S-CP.8
240	(6)	S-CP.8
243	(4)	SMP
251	(4)	S-CP.1
253	(4)	7.SP.7
255	(4)	A-REI.4
258	(5)	SMP
266	(5)	7.SP.5
269	(7)	7.SP.6

Proportional Reasoning

7	(4)	6.RP.3
15	(2)	6.RP.3
20	(4)	6.SP.2
21	(1)	6.RP.3
31	(2)	6.RP.1
51	(4)	8.EE.6
52	(3)	6.RP.3
68	(3)	6.RP.3
81	(4)	SMP
86	(3)	6.RP.3
94	(3)	6.RP.3
98	(4)	6.NS.1
121	(3)	6.RP.3
135	(3)	7.G.1
141	(4)	6.G.2
143	(3)	7.RP.3
147	(3)	6.RP.3
153	(3)	7.EE.4
155	(4)	6.RP.3
161	(3)	6.EE.7
182	(2)	6.G.1
194	(4)	6.EE.7
211	(3)	6.RP.3
241	(2)	6.RP.3
247	(3)	6.RP.1
248	(5)	6.RP.3
293	(4)	G-SRT.5
296	(4)	7.RP.1
298	(4)	7.G.6
300	(6)	7.RP.1

Solid Geometry

23	(5)	8.G.7
30	(3)	7.G.6
34	(4)	7.G.6
120	(4)	7.G.6
185	(4)	G-GMD.3
207	(3)	8.G.9
213	(4)	8.G.9
254	(4)	8.G.9
265	(4)	8.G.9
271	(3)	7.G.6
272	(3)	7.G.6
273	(3)	7.G.6
274	(3)	7.G.6
275	(3)	7.G.6
276	(5)	7.G.6
277	(5)	7.G.6
278	(5)	7.G.6
279	(5)	7.G.6
280	(5)	7.G.6
291	(4)	8.G.9
292	(4)	8.G.9
295	(4)	6.RP.3
297	(3)	G-GMD.3
299	(5)	G-GMD.3

Percents & Fractions

17	(4)	7.RP.3
24	(3)	7.RP.3
35	(4)	6.RP.1
46	(3)	6.RP.3
65	(3)	7.RP.3
78	(3)	7.RP.3
79	(3)	7.NS.2
85	(3)	7.RP.3
100	(4)	7.NS.3
111	(3)	7.RP.3
115	(3)	7.RP.3
117	(3)	6.RP.3
122	(2)	6.RP.3
131	(5)	6.RP.3
144	(4)	7.RP.3
152	(3)	7.NS.2
171	(2)	7.RP.3
178	(3)	7.NS.2
204	(2)	7.RP.3
237	(3)	7.RP.3

Coordinate Geometry

41	(3)	8.G.3
72	(4)	F-IF.2
76	(4)	8.EE.6
106	(3)	G-C.2
128	(5)	8.G.8
170	(5)	3.MD.7
172	(4)	7.RP.3
173	(4)	G-C.2
183	(4)	8.EE.6
217	(5)	8.F.3

Plane Geometry

48	(4)	8.G.7
69	(5)	7.G.5
83	(4)	7.RP.3
87	(3)	G-C.2
92	(4)	7.G.4
95	(3)	SMP
137	(4)	8.G.5
145	(3)	G-CO.10
146	(3)	7.G.6
168	(4)	7.G.4
174	(5)	G-SRT.5
192	(4)	G-SRT.6
209	(5)	7.G.4
220	(6)	8.G.7
227	(5)	8.G.8
239	(7)	G-C.2
242	(5)	G-SRT.6
257	(6)	SMP
294	(3)	G-SRT.5

Logic

37	(4)	SMP
58	(4)	7.NS.3
67	(4)	SMP
89	(3)	SMP
105	(2)	SMP
110	(4)	SMP
167	(5)	SMP
184	(3)	SMP
216	(5)	6.G.2
226	(3)	SMP
250	(4)	SMP
256	(5)	SMP
268	(5)	SMP

Sequences, Series & Patterns

8	(4)	G-CO.10
40	(4)	F-LE.1
163	(3)	F-BF.2
179	(3)	F-BF.2
189	(4)	F-LE.2
195	(4)	F-BF.2
206	(4)	F-LE.1
231	(5)	6.SP.5
233	(5)	F-BF.2
259	(4)	F-BF.2
289	(6)	6.SP.5

Measurement

1	(1)	2.MD.2
2	(2)	6.EE.7
19	(3)	G-SRT.5
27	(4)	8.G.7
28	(4)	6.G.1
50	(2)	6.G.1
55	(5)	7.G.4
60	(4)	7.G.6
88	(4)	7.G.5
90	(4)	7.G.6
104	(4)	8.EE.8
108	(5)	SMP
118	(3)	6.RP.3
123	(5)	3.MD.7
125	(5)	G-SRT.5
130	(4)	6.RP.3
140	(5)	7.G.6
142	(4)	8.G.7
148	(3)	8.G.7
158	(4)	SMP
160	(5)	G-CO.10
166	(5)	7.G.4
180	(5)	7.G.4
190	(4)	7.G.6
222	(5)	G-SRT.6
235	(4)	4.MD.3
236	(4)	6.EE.5
245	(5)	G-SRT.6
264	(4)	7.G.4

MATHCOUNTS® COMPETITION SERIES

2013-2014 ADDITIONAL STUDENTS REGISTRATION FORM

Step 1: *Tell us about your school so we can find your original registration (please print legibly).*

Teacher/Coach Name ______________________ Teacher/Coach E-mail ______________________

School Name ______________________ Customer # (if known) **A** - ___ ___ ___ ___ ___ Teacher/Coach Phone ____________

School Mailing Address ______________________ City, State ZIP ______________________

Step 2: *Tell us how many students you are adding to your school's registration. Following the instructions below.*

Please circle *the number of additional students you will enter in the Chapter Competition and the associated cost below (depending on the date your registration is postmarked). The cost is $30 per student added, whether that student will be part of a team or will compete as an individual. The cost of adding students to a previous registration is not eligible for an Early Bird rate.*

# of Students You Are Adding	1	2	3	4	5	6	7	8	9
Regular Rate *(postmarked **by** Dec. 13, 2013)*	$30	$60	$90	$120	$150	$180	$210	$240	$270
Late Registration *(postmarked **after** Dec. 13, 2013)*	$50	$80	$110	$140	$170	$200	$230	$260	$290

☐ My school qualifies for the 50% Title I discount, so the Amount Due in Step 4 will be half the amount I circled above. Principal signature required to verify Title I eligibility.

X ______________________

Step 3: *Tell us what your school's FINAL registration should be (including all changes/additions).*

TOTAL # of Registered Students	1 (1 individual)	2 (2 ind)	3 (3 ind)	4 (1 team)	5 (1 tm, 1 ind)	6 (1 tm, 2 ind)	7 (1 tm, 3 ind)	8 (1 tm, 4 ind)	9 (1 tm, 5 ind)	10 (1 tm, 6 ind)

Step 4: *Almost done... just fill in payment information and turn in your form!*

Amount Due ____________ ☐ Check *(payable to MATHCOUNTS Foundation)* ☐ Money order ☐ Purchase order # ____________ *(must include P.O.)*

☐ Credit card *(include all information)* Name on card ______________________ ☐ Visa ☐ MasterCard

Signature ______________________ Card # ______________________ Exp. ____________

Mail, e-mail a scanned copy or fax this completed form to:

MATHCOUNTS Registration | P.O. Box 441 | Annapolis Junction, MD 20701

E-mail: reg@mathcounts.org | Fax: 240-396-5602

Questions?
Please call the Registration Office at ***301-498-6141.***

THE NATIONAL **MATHCLUB** powered by **MATHCOUNTS**®

2013-2014 REGISTRATION FORM

Step 1: *Tell us about your group. Check and complete only 1 option.*

☐ ***U.S. school with students in 6th, 7th and/or 8th grade***

School Name: ______________________________

There can be multiple clubs at the same U.S. middle school, as long as each club has a different Club Leader.

☐ ***Chapter or member group of a larger organization.***
(Can be non-profit or for profit)

Organization: ______________________________

Chapter (or equivalent) Name: ______________________________

Examples of larger organizations: Girl Scouts, Boy Scouts, YMCA, Boys & Girls Club, nationwide tutoring/enrichment centers.

☐ ***A home school or group of students not affiliated with a larger organization.***

Club Name: ______________________________

Examples: home schools, neighborhood math groups, independent tutoring centers

Step 2: *Make sure your group is eligible to participate in The National Math Club.*

Please check off that the following statements are true for your group:

☐ My group consists of at least 4 U.S. students.
☐ The students in my group are in 6th, 7th and/or 8th grade.
☐ My group has regular in-person meetings.

By signing below I, the Club Leader, affirm that all of the above statements are true and that my group is therefore eligible to participate in The National Math Club. I understand that MATHCOUNTS can cancel my membership at any time if it is determined that my group is ineligible.

Club Leader Signature: ______________________________

Step 3: *Get signed up.*

Club Leader Name ____________________ Club Leader E-mail ____________________

Club Leader Phone ____________________ Club Leader Alternate E-mail ____________________

Club Mailing Address ______________________________

City, State ZIP ____________________ Total # of participating students in club: __________

☐ Previously participated in MATHCOUNTS. If previous participant, provide Customer # (if known): **A-**____ ____ ____ ____ ____

How did you hear about MATHCOUNTS? ☐ Mailing ☐ Word-of-mouth ☐ Conference ☐ Internet ☐ E-mail ☐ Prior Participant

For schools only: School Type: ☐ Public ☐ Charter ☐ Private ☐ Home school ☐ Virtual

If your school is overseas: My school is a ☐ DoDDS OR ☐ State Department sponsored school. Country ______________

Step 4: *Almost done... just turn in your form.*

Mail, e-mail a scanned copy or fax this completed form to:

MATHCOUNTS Registration | P.O. Box 441 | Annapolis Junction, MD 20701

E-mail: reg@mathcounts.org | Fax: 240-396-5602

Questions?
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