The Best of CML
1980 - 1989

CML

For information on the Continental Mathematics League, please contact:

CML, Inc.
P.O. Box 2196
St. James, NY 11780
(631) 584-2016

CML offers a set of Math League Questions for grades 2, 3 and two different levels of questions for grade 4, 5, 6, 7, 8 and 9. Also, a Calculus League is available as well as Computer Contests (PASCAL and C++).

The Best of CML
1980 - 1989

CM**L**

Continental Mathematics League

C M L
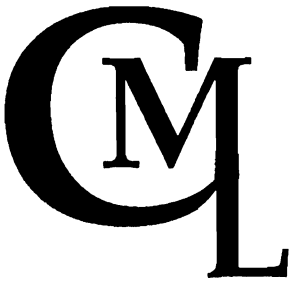
FORWARD

Welcome to <u>The Best of CML – 1980 to 1989</u>, an accumulation of some of the most challenging questions presented to CML participants during the 1980's.

Questions 1 - 103 were asked at the grade 4-6 level while questions 104 - 211 were used at levels from grade 7 through grade 9. Please keep in mind that, while a question is designated for a particular grade level in our Meets, it may be appropriate to a variety of other levels.

The book has a multitude of uses –

- it may be used as a supplement to "Gifted and Talented" curricula
- it may be used as a source for "extra-credit" questions
- it may be used as a source for "the problem of the week"
- it may be used as a preparatory guide for participation in mathematics contests or leagues such as CML
- *most importantly* it may be used to help students improve basic problem-solving skills

With this sampling of some of the most provocative questions that were posed to students during the past nine years, you have at your fingertips a resource for many enjoyable classroom experiences.

Edited by:

Henry Hull
Joseph Quartararo
Herman Ramakers

Spring 1989

CM
L

TABLE OF CONTENTS

1.) Jim has 4 more brothers than sisters. How many more brothers than sisters does his sister Mary have?

2.) A clock having the numbers 1 to 12 on its face chimes once for 1 o'clock, two times for 2 o'clock, three times for 3 o'clock and so on. How many times does a clock chime between 2:45 P.M. Tuesday and 2:45 P.M. the following day?

3.) The distance from Adams City to Biscayne is 107 miles. The distance from Biscayne to Callicoon is 32 miles. What is the shortest possible distance from Callicoon to Adams City?

4.) Joe can buy a dozen doughnuts for 80 cents. If he spends $16.00 for doughnuts and sells them for a total of $21.60, how much did he charge for <u>each</u> doughnut?

5.) Nine families live in a trailer park. Each family has less than seven members. If there are fifty-one people living in the trailer park, what is the least possible number of people in any one family?

6.) John and Bill agree to share some candy bars in the following way:

John gets 1, Bill gets 1
John gets 2, Bill gets 1 + 2
John gets 3, Bill gets 1 + 2 + 3
John gets 4, Bill gets 1 + 2 + 3 + 4

After the first 5 sharings, Bill will have _____ more candy bars than John.

7.) A is a certain number larger than 1. B is a certain number larger than 1. Which of the fractions has the largest value?

a) $\dfrac{A}{B}$ b) $\dfrac{A}{B+1}$ c) $\dfrac{A+1}{B-1}$ d) $\dfrac{A-1}{B+1}$

8.) Bottle A is 1/2 full of water. Bottle B will hold 12 pints of water. When the contents of bottle A are poured into bottle B, bottle B is 3/4 full of water. How many pints does bottle A hold when full?

9.) A train has 3 passenger cars. The number of people in car 2 equals the sum of the people in car 1 and car 3. At a station 5 people go from car 3 to car 2 and 7 people go from car 2 to car 1. Also, 6 people from car 1 get off the train. How many more people are now in car 2 than in car 1 and car 3 combined?

10.) The measures of the three angles of any triangle must add to 180°. In the triangle ABC angle A has a measure of 30°. Angle B is 4 times as large as angle A. How many degrees are there in angle C?

11.) Mr. Brown was going to sell 10 candy bars at 16¢ each. Two candy bars spoiled and could not be sold. At what price must each of the remaining 8 candy bars be sold so that he will receive the same amount of money as he would have received for the 10 candy bars?

12.) How many triangles are there in the diagram at the right?

```
         B
     D /|G|\ E
      /─┼─┼─\
     /__|_|__\
   A     F     C
```
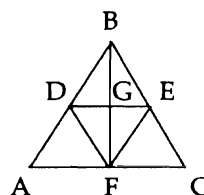
13.) Find the number that C represents in the subtraction problem at the right. (Whenever a symbol appears more than once, it represents the same number each time.)

$$\begin{array}{r} 6 \;\; * \;\; \# \\ - \; C \;\; 8 \;\; \# \\ \hline 1 \;\; @ \;\; * \end{array}$$

14.) You are the first generation and your two parents are the 2nd generation of your family. Your two pairs of grandparents are the 3rd generation. How many people are in the 6th generation of your family?

15. In the figure at the right all angles are right angles. If AB = 18, BC = 2, CD = 6, DE = 3, HG = 8 and HA = 8, find the area of the shaded region.
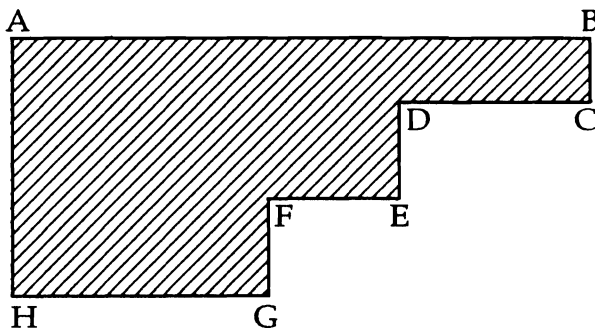
16.) On Monday, Mike had 450 football cards. On Tuesday, he lost 40 cards. On Wednesday, he won 50 cards. He then put his cards into 4 equal stacks. How many cards were in each stack?

17. Bob and Carol are teenagers. Bob is two years older than Carol. If the digits of Carol's age are reversed, the new number would be three times as large as Bob's age. Find Bob's age.

18.) Both Ken and Lucy have baseball cards. If Lucy gave Ken 10 of her cards, they would have the same number of cards. However, if Ken were to give Lucy 10 of his cards instead, then Lucy would have 5 times as many baseball cards as Ken would have. Find the <u>total</u> number of baseball cards <u>both</u> Ken and Lucy have.

19.) There were 5 horses in a race, "A", "B", "C", "D", and "E". "A" did not win. "B" came in 20 yards behind "A". "D" came in 10 yards ahead of "C". "E" came in 15 yards ahead of "B". Which horse won the race?

20.) Two teams decide a touchdown is worth 5 points and a field goal is worth 3 points. What is the highest score a team cannot reach with any combination of touchdowns and field goals?

21.) In the diagram at the right, sections with the same letter have the same length. Find the length of a "y" section.
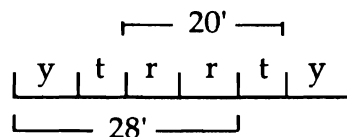
22. Five spoons and 2 glasses weigh as much as 3 plates. One plate weighs as much as 1 spoon and 1 glass. How many spoons weigh as much as 1 glass?

23. Bill writes the number 1. He then skips one number and writes the number 3. He then skips two numbers and writes the number 6. He then skips three numbers and writes the number 10. If he continues this pattern, what number will Bill write after he skips 10 numbers?

24. ABCD is a square. AB = 12. Other lengths are shown. Find the total area of the two shaded regions.
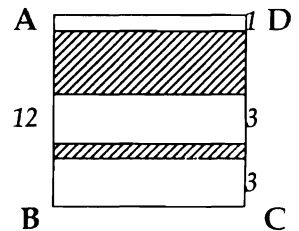
25. Nancy went shopping with a certain amount of money. In the first store she spent 1/2 of her money. In the second store she spent 1/4 of her money. In the third store she spent 1/8 of her money. She then had $9 left. How much money did Nancy have when she started her shopping?

26. Mr. Allen and Mr. Baxter are both walking east on Main Street. Mr. Allen walks one block in one minute and Mr. Baxter walks 3 blocks in 2 minutes. At 1:30 P.M. Mr. Allen is 4 blocks ahead of Mr. Baxter. At what time will Mr. Baxter catch up to Mr. Allen?

27. Eight women form a tennis club and arrange for each person to play each other exactly once. How many tennis matches must be arranged?

28. In the product 7x8x9x10x11x12, which one of the six numbers should be increased by 1 to cause the greatest increase in the product?

29. Denise operates a machine in a factory that produces a ball point pen every five seconds. She starts work at 8:00 A.M., has half-an-hour off for lunch, and stops work at 4:00 P.M. How many ball point pens does she produce each day?

30. Three painters, all working at the same rate, paint 2/3 of a house in 6 hours. The following day only one painter returns. How many hours will the painter, working at his regular speed, need to finish painting the house?

31. 30,000 bananas are packed in boxes. There are 500 bananas in each box. Equal numbers of boxes are then put on carts. If 10 carts are needed, how many boxes are there on each cart?

32. Numbers beginning with 0 are presented on a screen, as shown. There are no spaces between digits. Zero is the first digit listed. If 40 digits can fit in the row, what is the last digit in the row?

    0123456789101112...

33. David and Allen flipped baseball cards. Each time a player won the flip, the loser gave him one card. When they finished, David had won 3 times and Allen had 8 more cards than when he started. How many times did they flip cards?

34. Arthur invented a new system for counting eggs. He showed the class these examples:

	Arthur's System	Our System
3 dozen 5 eggs	35	41
5 dozen 7 eggs	57	67

    What number in our system would be worth 81 in Arthur's System?

35. Jerry has chickens and sheep. In his field he counts 17 heads and 60 feet. How many sheep does Jerry have?

36. At a drive-in movie there is a fixed charge for the driver and one passenger and an extra charge for each additional passenger. If six people must pay $8 and three people must pay $4.25, what is the fixed charge for the driver and one passenger?

37. An ancient ruler is 9 inches long. The only marks that remain are at 1 inch, 2 inches, 9 inches and one other mark. It is possible to draw line segments of whole number lengths from 1 inch to 9 inches without moving the ruler. What inch number is on the other mark?

38. Alex is a faster runner than Bob. Alex runs 3 yards every second. Bob runs $2\,{}^1/_2$ yards every second. Alex gives Bob a 30 yard head start in a race and reaches the finish line exactly 2 seconds before Bob. How many yards did Alex run?

39. There are two large blocks and four small blocks on a scale. The six blocks weigh a total of 26 pounds. The small blocks weigh the same and the large blocks weigh the same. Two small blocks together weigh 1 pound less than one large block. How many pounds does one small block weigh?

40. The figure at the right shows a rod with black beads and white beads. How many beads must be slid from the right side to the left side so that one-fourth of the beads on each side are black?

41. The nine regions in the diagram at the right are to be colored. No two regions that touch one another can have the same color. What is the least number of colors that can be used?
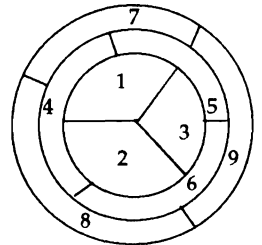
42. Rick has 10 coins in his pocket (no silver dollars). He does not have exact change for a dollar, a half-dollar, a quarter, a dime, or a nickel. How much money does Rick have in his pocket?

43. Two watches are set at 7:00 A.M. One watch runs 3 minutes fast every two hours. The other watch runs one minute slow every two hours. At what time the next day will the faster watch be one hour ahead of the slower watch?

44. Carlos and Peggy weigh 121 pounds together. Peggy and Gina weigh 95 pounds together. If all 3 children weigh 174 pounds together, then Peggy's weight is _____ pounds.

45. On a weight scale, 5 plums and 1 apple balance with 1 pear. Two apples and 1 pear balance with 11 plums. Fruit of the same kind weigh the same. How many plums would balance 1 pear?

46. Five bags contain a total of 50 tennis balls. The first and second bags contain a total of 21 tennis balls, the second and third contain 20 tennis balls, the third and fourth contain 21 tennis balls and the fourth and the fifth contain 27 tennis balls. What is the total number of tennis balls in the first and fifth bags?

47. John agreed to mow Mrs. Lewis' lawn 20 times last summer for $150 and a new radio. After he mowed the lawn 10 times, he received $30 and the radio. What is the value of the radio?

48. One skip = 3 hops, and 1 jump = 2 skips. How many hops are there altogether in a hop, a skip, and a jump?

49. Cookies were missing, taken by either Tim, Kim or Jim. Each made a statement to their mother:　　　Kim:　Jim took the cookies.
　　　　　　　　　　　　　Jim:　That is true.
　　　　　　　　　　　　　Tim:　I did not take the cookies.
If at least one of them lied and at least one of them told the truth, then who took the cookies?

50. Mr. Avery has 3-foot boards and 4-foot boards. If he puts the 3-foot boards in a line, they have the same total length as the 4-foot boards put in a line. Altogether he has between 16 and 25 boards. How many 3-foot boards does he have?

51. A group of 30 people went to a ballgame, some in cars and some on a bus. Going, 15 people rode in the bus and 5 people rode in each car. Coming back, 4 people rode in each car. How many people came home by bus?

52. In a 3-hour examination of 320 questions, there are 40 questions on science. Twice as much time is given to each science question as to the other questions. How much time is allotted to the 40 science questions?

53. Alice and Cindy start together and race their bikes around a circular track at constant speeds. Alice takes 8 minutes to go 1 lap and Cindy takes 5 minutes. How long will it take for Cindy to be exactly 1 lap ahead of Alice?

54. In the multiplication problem at the right, find the sum of the digits D + E.

$$
\begin{array}{r}
A3 \\
\times\ BC \\
\hline
-- \\
--8 \\
\hline
DE66
\end{array}
$$

55. Mr. Bond packages shirts in 2 different size boxes. Box "A" holds 5 shirts and box "B" holds 12 shirts. He packages 99 shirts using more than 10 boxes. How many boxes of the "A" type did he use?

56. On the line ⌊—1—⌊—1—⌊——3——⌋ (A B C D), all the distances from 1 to 5 can be found between two of the points: AB = 1, AC = 2, CD = 3, BD = 4 and AD = 5. On the line ⌊—1—⌊—1—⌊————⌋————⌋ (E F G H I), EF = 1 and EG = 2. Find GH and HI so that there are all the distances from 1 to 9.
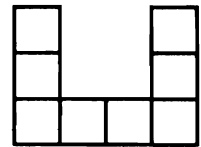
57. Each different letter represents a different digit and AC, BC and CH represent 2-digit numbers. A letter represents the same digit each time it appears. AxB = B; BxC = AC; CxD = BC; and DxE = CH. Find the digit that E represents.

58.   The figure at the right is formed by 8 squares
      of the same size. The area of the figure is 128
      square feet. The perimeter of the figure is
      _____ feet.

59.   In a strange land a clock has only 10 hours on its face. The hour hand moves 6 units
      as the minute hand moves 60 units. At 6:00 A.M. the minute hand is on the number
      10 and the hour hand is on 6. In how many minutes will the two hands next be
      together?

60.   What is the unit's digit for the product of 1 x 2 x 3 x 4 x 5 x 6 x 7 x 8 x 9?

61.   If S is the sum of the remainders when each number in the list {8, 11, 15, 29, 48} is
      divided by 5, what is the remainder when S is divided by 5?

62.   Each circle represents a bag and the number of
      dollars in each bag. As many bags can be taken
      as long as no two are on the same diagonal line.
      The largest amount of money that can be taken is
      _____ dollars.
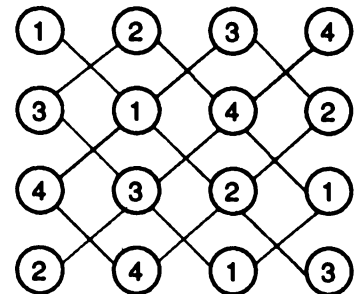
63.   Find the smallest number that must be added to 70808 so that the digits would
      read the same backward or forward.

64.   At 6:00 A.M. trains start from station $\textcircled{x}$ and station$\textcircled{y}$. All trains from station $\textcircled{x}$
      to station$\textcircled{y}$ and from$\textcircled{y}$ to $\textcircled{x}$ take one hour. A train leaves each station for the
      other at the same time every 5 minutes. If a train leaves station$\textcircled{x}$ at 2:00 P.M., how
      many trains will it meet <u>on</u> the way (not at the station)?

65. The average of a list of 6 numbers is 43. If two numbers are added to this list, the average is 51. What is the average of the two numbers that were added to the list?

66. Don, Liz and Tom are playing bingo. There are 25 squares on a bingo card. When bingo is called, Tom has 8 blank spaces. This is 3 more blank spaces than Liz has. How many spaces does Liz have covered?

67. Jim and Barbara each want to buy the same kind of pen. Jim still needs 24¢ to buy the pen and Barbara still needs 4¢ to buy the pen. If they combine their money, they still do not have enough. What is the *most* the pen could cost?

68. Today Janet's age in years is three times her dog's age in months. In one year, the dog's age in months will be 2 times Janet's age then, in years. Today Janet is _____ years old.

69. The classrooms in Hank's school are numbered 1 to 12. The first teacher opens all the doors. The second teacher closes the doors of the even-numbered rooms. The third teacher changes every third door, opening the ones that are closed and closing the ones that are open. How many of the 12 doors are open after the third teacher finishes?

70. Mr. Baker, Mr. Carpenter, and Mr. Plumber work as a baker, a carpenter, and a plumber. None of them has a job which is the same as his name. Mr. Carpenter's wife is the baker's sister. What is Mr. Plumber's job?

71. A stairway has less than 20 steps. If Tony goes up 2 steps at a time, then one step is left at the end. If he goes up 3 steps at a time then 2 steps are left. If he goes up 4 steps at a time then 3 steps are left. How many steps does the stairway have?
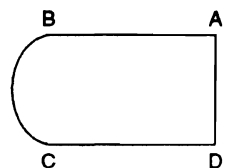
72. In the 1800's a wagon train had 96 wagons each carrying the same number of people. When 12 wagons broke down each of the other wagons had to carry one more person. How many people were there in each wagon originally?

73. A piece of wire 66 mm. long is cut into two pieces. One piece is shaped into a square and the other into an equilateral triangle (a triangle with 3 equal sides). Each side of the square is twice as long as each side of the triangle. The area of the region inside the square is _____ sq. cm.

74. In a certain cave 2 bats could see out of the right eye, 3 could see out of the left eye, exactly 4 could not see out of the left eye and exactly 5 could not see out of the right eye. What is the smallest number of bats in the cave?

75. A palindromic number reads the same forwards as it does backwards: i.e. 252, 3773. If a number is *added* to its reversal and this is repeated enough times, then a palindromic number is formed. For example choose 58; 58 + 85 = 143, 143 + 341 = 484 which is palindromic. What is the lowest number of additions needed to reach a palindromic number if 78 is chosen?

76. Eighteen people, numbered 1 - 18, are equally spaced around a round table. What is the number of the person directly across from the person numbered 6?

77. The year 1961 has the rare property of reading the *same* when the paper is turned upside down. Only 0, 1, 6, 8 and 9 form digits upside down. When is the next year after 1961 that has this property?

78. The first time Larry plays a video game, he is knocked out in 30 seconds. The next time he plays 30 seconds longer, and the third game is 30 seconds longer than the second. Larry is able to play 30 seconds longer each game. It costs him 25¢ to play a game. How much will it cost Larry to last 4 minutes before he is knocked out?

79. A palindromic number reads the same forwards as backwards. For example: 88, 373, 6776. How many palindromic numbers are there between 10 and 200?

80. Three equal fractions such as $\frac{3}{6} = \frac{7}{14} = \frac{29}{58}$ uses all nine digits 1, 2, 3, 4, 5, 6, 7, 8, 9 once and only once. Find two 2-digit numbers, ab and cd, so that $\frac{3}{6} = \frac{9}{18} = \frac{ab}{cd}$ also use these nine digits.

81. John is taller than Henry. Henry is shorter than Mike. Mike is older than Richard who is John's older brother. The heights of the boys are such that the <u>older</u> they are, the <u>shorter</u> they are. The second tallest boy is _____.

82. The arrangement $^{a}{}_{c}{}^{b}$ means a – (b x c). For example, $^{7}{}_{3}{}^{2}$ means 7 – (2 x 3) = 7 – 6 = 1. Find the number $^{21}{}_{3}{}^{6} + {}^{30}{}_{7}{}^{3}$ represents.

83. Mr. Roberts has 20 students in his class. He has enough balloons to give each student 3 balloons. Ten students want only one balloon each. How many balloons can Mr. Roberts give to each of the remaining students if he wishes each of them to have the same number of balloons?

84. Debbie has 42 marbles and Chris has 24 marbles. How many marbles should Debbie give to Chris so that they both have the same number of marbles?

85. Phil had 2 quarters, 1 dime and 3 pennies. Paul had 2 nickels. Phil gave 3 of his coins to Paul. Paul then had 1¢ more than Phil. What 3 coins did Phil give to Paul?

86. Amy ran around the track 3 times for a total of 810 meters. The track distance from B to C is 80 meters and from D to A is 50 meters. The distance from A to B is the same as from C to D. The distance from A to B is _____ meters.

87.   A dollar is changed into 9 coins. There are more dimes than nickels and no pennies. How many nickels are there? (Quarters and half-dollars may be used.)

88.   Two hamburgers and two colas cost $4.20. Two orders of french fries and two colas cost $2.64. If one hamburger, one order of french fries and one cola cost $2.65, what is the cost of one cola?

89.   A container half full with water weighs 12 pounds. One-third of the water <u>in</u> the container is poured out. The container and the remaining water weighs 9 $^1/_2$ pounds. The weight of the container when empty is _____ ?

90.   Jill runs 3 times as fast as Sarah. But Alice runs 4 times as fast as Sarah. When Alice and Jill race 60 yards, Jill will be _____ yards behind when Alice crosses the 60 yard line.

91.   Steve has 8 small cubes all of equal weight and 4 large cubes also of equal weight. One large cube weighs the same as 3 small cubes. If the total weight of all 12 cubes is 10 pounds, the total weight of 2 small cubes plus 1 large cube would be _____ pounds.

92.   In the addition problem at the right, find the <u>largest</u> possible sum by substituting the digits 1, 3, 5, 7 for the four letters. (A letter represents the same digit every time it appears. Different letters represent different digits.)

$$\begin{array}{r} R\ A\ T \\ B\ A\ T \\ +\ \underline{T\ A\ B} \end{array}$$

93.   In the problem at the right, find the number represented by the digits R, S, T.

$$\begin{array}{r} R\ S\ T \\ \times\ \underline{7\ 4\ 1} \\ -\ -\ - \\ -\ -\ -\ - \\ \underline{-\ -\ -\ -} \\ \overline{-\ -\ -\ 1\ 4\ 7} \end{array}$$

94. It takes Sophia 15 minutes to walk from her home to where her bike is being repaired. It takes her only 5 minutes to ride home. She lives 3/4 of a mile from the bike store. If Sophia were to ride her bike for 1 hour at that rate she would ride _____ miles.

95. Laura and Rebecca had a race. Rebecca was given a 30-yard headstart (Laura 30 yards behind the starting line). When Laura crossed the finish line, Rebecca had run 150 yards and was 15 yards behind Laura. How many yards did Laura run?

96. Three open switches are in a row: ___ x ___ , ___ y ___ , ___ z ___
     z can be opened or closed at will. y can be opened or closed only if z is closed.
     x can be opened or closed only if y is closed and z is open. If all 3 switches are open, then what will be the fewest number of switch changes to get all three in closed positions?

97. Al, Bob, Carl and Don are on swings side by side. They start off together but go at different speeds. Al crosses the beginning point 20 times a minute, Bob 12 times a minute, Carl 4 times a minute and Don 8 times a minute. During the 1st minute *after* they start swinging, all four boys were together at the "starting point" exactly _____ times?

98. How many whole numbers between 200 and 699 have no digits repeated within the number?

99. Starting with the counting numbers from 1 to 103 eliminate all those divisible by 5. Add 1 to each remaining number and again eliminate those divisible by 5. Once again add 1 to each remaining number and eliminate all those divisible by 5. How many numbers remain?

100. When it is 9:00 A.M. in New York, it is 8:00 A.M. in Chicago, 7:00 A.M. in Denver and 6:00 A.M. in Los Angeles. Use this information to solve the following problem: Beth left New York in a plane at 5:00 P.M. On the same day Joanne left Los Angeles by plane. After a 3-hour flight by Beth and a 6-hour flight by Joanne, they landed at the same time in Chicago. What time was it in Los Angeles when Joanne left to fly to Chicago?

101. Elaine, a printer, is going to hand-set the page numbers for a book. It takes her one minute to set a single digit on the page. She starts at noon and finishes at 3:33 P.M. that day. How many numbered pages does the book have?

102. A counselor wanted to divide apples equally among some boys, If he gave them 5 each, then he would have 10 apples left over. One boy said he did not want any apples. The counselor then gave 6 apples to each boy and had 3 apples left over. How many boys were there?

103.

					B	A								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

If a counter is placed or finishes its move on an odd-numbered square, then it moves 3 to the left, and if it finishes on an even-numbered square it moves 5 to the right. Counter A is placed on square 7 and counter B on 6. It takes B _____ fewer moves than A to reach 15.

104. A pumpkin farm charges a fixed amount for the first three pumpkins purchased and an extra amount for each additional pumpkin purchased. If the cost of seven pumpkins is $15.00 and the cost of ten pumpkins is $21.00, what is the fixed charge for the first three pumpkins?

105. If $K \times 2^3 \times 5^4 = 10^5$, find K.

106. Find the first possible case where a set of consecutive whole numbers satisfies the following description: prime, composite, prime, composite, perfect square, composite, prime, composite, prime. (Your answer should consist of 9 consecutive whole numbers.)

107. Four (4) is the smallest perfect square number that meets the following requirements:
    a)   If it is decreased by one, the new number is a multiple of three.
    b)   If it is increased by one, the new number is a multiple of five.
    What is the next perfect square that meets both requirements?

108. Freida must take a 4-hour examination containing 200 questions, 50 of which are math questions. Twice as much time should be allowed for each math question as for each other type question. What is the total number of minutes she should allow for the math questions?

109. Tour A leaves every 15 minutes and takes $2^1/2$ hours to complete. Tour A passes the waterfall halfway through the tour. Tour B leaves every 15 minutes and takes 1 hour to complete. Tour B passes the waterfall one-fourth of the way through the tour. If John takes Tour A at 1:30 P.M., when should Bob take Tour B so that the two tours arrive at the waterfall at the same time?

110. Find the least number of triangles into which a hexagon may be divided by drawing diagonals in the hexagon.

111. A row of seats in a stadium has 100 seats. If 12 people sit in a row so that there are 2 empty seats between any person and the next person, how many empty seats in the row are not between the two end people?
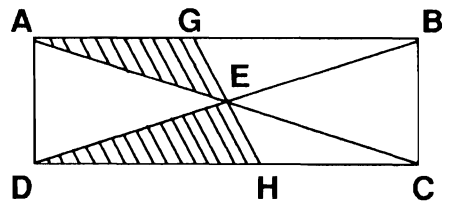
112. ABCD is a rectangular region with area 336 square inches. How many inches are there in the perimeter of the large rectangle ABCD?
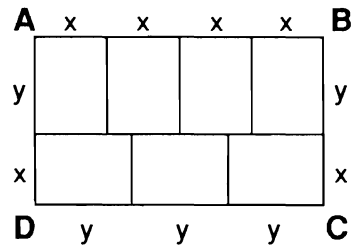
113. A circle is inscribed in square ABCD. E, F, G and H are the midpoints of the sides of square ABCD. If the area of the shaded region is $\pi - 2$ square units, find the length of $\overline{AB}$.
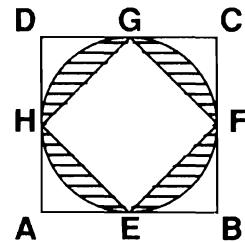
114. In the rectangle ABCD, AB = 12, AD = 4. Find the area of the shaded region.

115. A new train goes 20% further in 20% less time than an old train. By what % is the average speed of the new train *greater than* that of the old train?

116. A merchant buys cloth at $1.60 per yard. At what price per yard should he list the cloth so that he may sell it at a discount of 20% from the list price and still make a profit of 20% of the sale price?

117. A six-pointed star (as shown) is formed by taking equilateral triangle ABC, flipping it over to form triangle DEF, and placing the 2nd triangle on the first so that all sides intersect at trisection points. Express, in *simplest* form, the ratio of the area of the entire star to the area of the original triangle ABC?
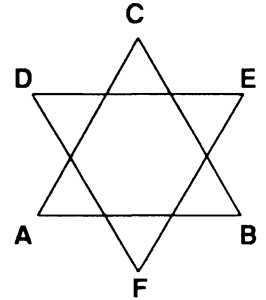
118. Find the average of all numbers from 1 to 100 that end in 2.

119. A runner wishes to travel 1100 meters. She plans to do this by first running 200 meters at the rate of 8 meters per second, then walking 200 meters at the rate of 2 meters per second and then repeating this process until she has gone 1100 meters. How many seconds did she need in order to travel the full distance?

120. A rectangular lawn is 120 feet long and 80 feet wide. Ted's lawn mower cuts a path one foot wide. If Ted started along the outside of the lawn and mowed around the outer portion of the uncut lawn twenty times, what fractional part of the lawn had he mowed? (Your answer must be in *simplest* form.)

121. The Port Royal football team scored one-third its points in the 1st quarter, one-fourth its points in the 2nd quarter, one-sixth its points in the 3rd quarter and the remaining points in the 4th quarter. If the Port Royal team won by 2 points and the combined scores for both teams was 70 points, how many points did the Port Royal team score in the 4th quarter?

122. AEFL is a square. $\overline{MF}, \overline{LN}, \overline{AB}, \overline{BC}, \overline{CD}, \overline{DE}$ are all equal segments and have a length of 1 unit. Find the area of the shaded region.
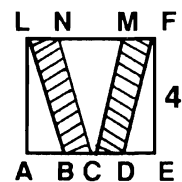
123. A train starts its 221 mile trip at 7:30 A.M. If the train travels at an average speed of 34 miles per hour and stops exactly four minutes at each of ten stations, at what time in the afternoon will it arrive at its final destination?

124. One news carrier can deliver 75 newspapers in 2 hours. How many newspapers can 4 news carriers deliver in 3 hours?

125. $\overline{AO}$ is the radius of the larger circle and the diameter of the smaller circle. Find the ratio (in simplest form) of the area of the shaded region to the area of the larger circle.
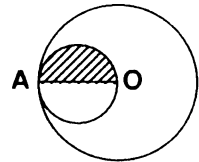
126. A 4-liter mixture of milk and coffee is 20% milk. A liter of pure coffee is added to this mixture. What percent of the new mixture is milk?

127. A model train follows the "figure eight" as shown making a complete loop of both circles arriving back at A. If the train covers 16π ft. and the radius of the large circle is 6 ft., find the radius of the smaller circle.
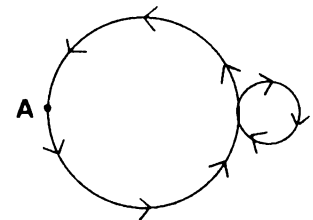
128. Each edge of a cube is increased by 50%. The <u>percent</u> of increase in the surface area of the cube is: a) 50   b) 125   c) 150   d) 300   e) 750

129. Two cups, A and B, are exactly the same size and half filled – A with only milk and B with only coffee. A teaspoon of coffee is taken from B and mixed thoroughly with the milk in A. Then, a teaspoon of the new mixture in A is transferred to B. Which of the following statements is true? *1)* There is more coffee in A than milk in B. *2)* There is less coffee in A than milk in B. *3)* The amount of coffee in A and milk in B are exactly the same.

130. The star is formed by 2 congruent equilateral triangles which intersect at trisection points. Rectangle BDHJ is drawn. If a side of the equilateral triangle (AE) is 6 inches, find the area of rectangle BDHJ.
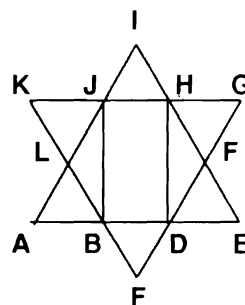
131. One edge of a ruler is to be marked in $\frac{1}{8}$ inch units and $\frac{1}{6}$ inch units. How many different marks are needed from the 2-inch mark to the 3-inch mark, including those 2 marks?

132. The face of a clock is divided into 60 equal units. The hour hand moves 5 units every hour. At 9 A.M. the minute hand is 45 units behind the hour hand. In how many minutes will the minute hand be one unit behind the hour hand.

133. If Joan races her bicycle at 15 miles per hour, she will pass a checkpoint at 11:00 A.M. Sue, starting together with Joan, races her bicycle at 10 miles per hour. She passes the same checkpoint 2 hours later. How many miles is the checkpoint from where the girls started?

134. In the addition problem at the right, A, B, C, D and E represent different digits. Everywhere a particular letter appears it represents the same digit. Find the digit "B" represents.

```
  A B C D
  A B C D
  A B C D
+ A B C D
  E B E A
```

135. If the first day in a year is a Tuesday, then the first day in the next year advances one day to be a Wednesday. If it is a leap year, then it advances 2 days. If Jan. 1, 1901 was a Tuesday, then what day of the week will it be on Jan. 1, 2001? (There are 25 leap years in this period.).

136. A "Druid" and a "Meef" weigh 7 pounds. Two "Meefs" and one "Zarp" weigh 9 pounds. A "Druid" and a "Zarp" weigh 4 pounds. How many pounds does one "Meef" weigh?

137. An escalator moves up at a rate of so many steps per second. A man walks up the escalator at his own rate of one step per second and reaches the top in 20 seconds. The next day his rate was 2 steps per second and he reached the top in 16 seconds. How many steps does the escalator have?

138. On Arbor Day a group of students planted a tree that was 10 feet high. Each year the tree increased its height by x feet. During the sixth year it increased its height by $\frac{1}{11}$ of the height it had reached at the end of the fifth year. How many feet high was the tree at the end of the sixth year?

139. A mixture of green dye contains 3 pints of blue dye and 1 pint of yellow dye. A mixture of orange dye contains 2 pints of red dye and 2 pints of yellow dye. If the green mixture and the orange mixture are used to fill a one gallon pail, what <u>percent</u> of the new mixture is yellow dye?

140. Alan is a faster runner than Bill. Alan runs 3 yards every second; Bill runs $2\frac{1}{2}$ yards every second. Alan gives Bill a 35 yard headstart in a race and reaches the finish line exactly 2 seconds before Bill. How many yards did Alan run?

141. Standings in a soccer league after each team played every other team once:

	Won	Lost	Ties	Goals For	Against
Scotland	3	0	0	7	1
England	1	1	1	2	3
Wales	1	1	1	3	3
Ireland	0	3	0	1	6

If Scotland beat England 3-0, what was the score of the game between England and Ireland?

142. Each different letter represents a different digit and AC, BC and CH represent 2-digit numbers. A letter represents the same digit each time it appears. A x B = B; B x C = AC; C x D = BC and D x E = CH. Find the digit H represents.

143. A 3-digit number, ABC, when multiplied by 321 gives a product with the digits 1, 2 and 3 occupying the last 3 places of the product. Find the number represented by ABC.

```
        A B C
    x   3 2 1
        - - -
      - - - -
    - - - -
    _____
          1 2 3
```

144. Al is 100 yards from Bill and Bill is 300 yards from Chuck. They all move to the right at constant speeds. In 6 minutes Al overtakes Bill and in another 6 minutes Al overtakes Chuck. How many minutes did it take Bill to overtake Chuck?

```
    |   100   |       300       |
    A         B                 C
```
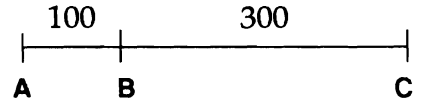
145. A motel is owned by three people. Mrs. X owns $\frac{3}{5}$ of the motel, and Mr. Y owns twice as much as Mr. Z. What fraction of the motel does Mr. Z own?

146. A train traveling 88 feet per second takes three seconds to enter a tunnel and another thirty seconds to pass completely through it. What is the length of the train in feet?

147. In 1928 there were four dates in which the month times the day was equal to the year (last 2 digits). 1/28/28; 2/14/28; 4/7/28;7/4/28. In which year of this century are there the most of these kinds of dates <u>and how many</u>?

148. Clock "A" loses 1 minute a day and clock "B" gains $1\frac{3}{5}$ minutes a day. If clock "B" is 17 minutes ahead of clock "A", then how many days will it take clock "B" to be 30 minutes ahead of clock "A"?

149. How many different routes are there from point A to point B, if the movement must be to the right or down?
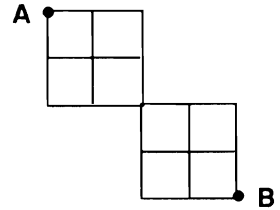
150. What is the unit's digit in the number 4^{478}?

151. Tom climbs stairs 5 steps at a time and Bob goes up 4 steps at a time. At a certain step, Tom is 9 steps from the top and Bob is 2 steps behind Tom. What is the fewest possible number of steps for these stairs?

152. On Monday a store put out 10 watermelons to be sold and some were sold. On Tuesday the number left over was doubled and again the same number were sold as on Monday. On Wednesday the number left over was tripled and the same sold as on Monday leaving none left over. How many were sold each day?

153. Each of 5 people have a car with a full one-gallon gas tank. Each car goes 10 miles on a gallon. They all can carry at most 5 one-gallon cans of gasoline. They start together and wish to have one car go as far due west as possible and yet have all the cars return. Only unopened cans can be transferred to other cars. What is the most miles due west that one car can go?

154. Thirty students took a test. The average grade for the whole class was 70 and the average of the twenty who passed was 80. What was the average of those who failed?

155. Joe walks to Hank's house in 12 minutes. It takes Hank only 8 minutes to walk the same distance to Joe's house. Joe walks to Al's house in 8 minutes. It takes Al 12 minutes to walk the same distance to Joe's house. If Joe walks at the same rate to both his friends, what is the ratio of Hank's rate of walking to Al's rate of walking?

156. There are 120 numbers that can be formed using all 5 digits 1, 2, 3, 4 and 5. There are 24 of these numbers beginning with each digit. If these numbers are arranged in increasing order: 12, 345; 12, 354; 12, 435; 12, 453 up to 54, 321. Which one of these numbers is the 75th in this order?

157. John runs at a constant speed from A to E to C. Tom runs at a constant speed from B to C. When John gets to point E, Tom is ahead by 30 yards. When John reaches point C he is _____ yards ahead of Tom.

A _____ D
550 yds.
110 yds.
330 yds.
B   E C
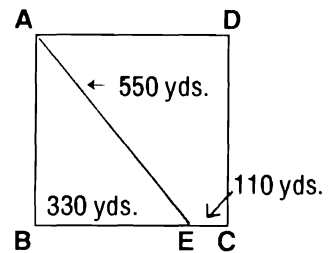
158. Mr. G. and Mr. H. work in the same building and live next to one another. Mr. G. travels by bus and Mr. H. travels by train. The train route is $1\frac{1}{2}$ miles longer than the bus route. The bus travels at a rate $\frac{2}{3}$ of the rate of the train. They start at the same time and arrive together. What is the distance of the route taken by the train?

159. There are 6 empty cans and 3 boxes filled with the same number of marbles. Each can is given $\frac{1}{12}$ of the marbles in each box. Each box now has 12 more marbles than each can. How many marbles did each box have at the beginning?

CANS   BOXES
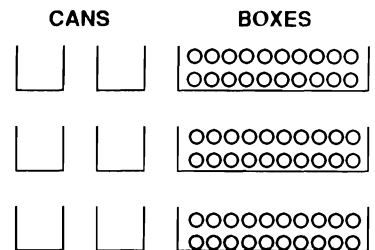
160. Mike is assigned to find the speed of the current of the Lima River. He tosses a leaf into the river. The leaf takes 9 seconds to pass under a bridge 33 feet wide. Find the speed of the current in miles per hour. (5280 feet = 1 mile)

161. How many whole numbers from 100 to 1000 contain the digit 6 exactly twice?

162. There is a train depot in each of 7 cities. Each train depot has a direct line of communication with the other depots. How many lines of communication are there among the 7 cities?

163. The average of A and B is X. The average of C, D and E is Y. What is the average of A, B, C, D and E in terms of X and Y?

164. A piece of cardboard like the one shown at the right is made up of five congruent squares and has an area of 80 square inches. If the cardboard was folded along the dotted lines in order to make a box (with no top), the volume of the box would be _____ cubic inches.
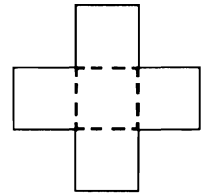
165. Two glasses of the same size contain pure orange juice. One is 1/3 full and the other is 1/4 full. Both are filled with water and poured into a container. Half of the mixture is poured back into one of the glasses. What part of this is pure orange juice?

166. ABCD is a rectangle. E is the midpoint of $\overline{AD}$ and F is the midpoint of $\overline{CD}$. $\overline{EF}$ is the diameter of circle O. If AB = 16 and BC = 12, find the area of circle O. (Express your answer in terms of π.)
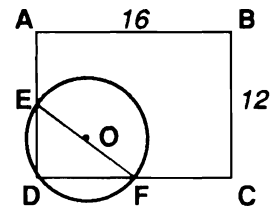
167. There are less than 15 houses on one side of the street that are numbered 2, 4, 6, etc. Mrs. Lewis lives in one of these houses. The numbers of all the houses numbered below hers have the same sum as all those numbered above her. How many houses are on her side of the street?

168. Willis has an equal number of nickels, dimes and quarters. He can put the same number of each of the three types of coins in 8 bags. All of this money can be put into 7 bags with equal numbers of nickels, dimes and quarters. The same condition can be done with 6 bags but not with 5. What is the smallest amount of money contained in all the bags?

169. Two apples and three bananas cost 33¢. Four apples and seven bananas cost 71¢. The cost of one apple and five bananas is _____ ¢.

170.   The evil warlord, Beldark, has locked the beautiful princess, Alcana, in a dungeon. Before he lets her out she must find the first perfect square number larger than 100 where the _sum_ of the digits is not a perfect square. Help her by finding that number. ($6^2 = 36$, 36 is a "perfect square".)

171.   Multiplying 4 times 2178 gives an answer that is the reverse of 2178; 4 x 2178 = 8712. Find the four digit number that when multiplied by 9 does the same thing.

172.   A man cycles to work alongside a railroad track at 6 M.P.H. Every day he arrives at a crossing at the same time that a train does. One day he was 50 minutes late and was overtaken by the train 6 miles from the crossing. In how many minutes will the train reach the crossing?

173.   The year 1961 has the rare property of reading the _same_ when the paper it is on is turned upside down. Only 0, 1, 6, 8 and 9 form digits upside down. What is the next year after 1961 that has this property?

174.   Scott gave Ken an amount of money equal to what was in Ken's pocket. Ken then gave Scott an amount of money equal to what Scott had left. Ken now had $10 and Scott had $8. How much money did Ken originally have in his pocket?

175.   There are 24 numbers that can be formed from the digits 1, 2, 3 and 4 using each digit once and only once. (Each digit appears 6 times in each of the 4 places _ _ _ _). What is the sum of these 24 numbers?

176.   For the numbers: 1, 2, 3, 4, 5, 6, 7, ⑧ , 9, 10, 11, 12, 13, 14, 15, the numbers less than 8 add up to 28 and those more than 8 add up to 84. Pairs of numbers, one on each side of 8, can be interchanged to change these sums. What is the fewest number of interchanges that will make the sums on either side of 8 equal?

177. The numbers 3, 4, 5 and 5, 12, 13 are the sides of two right triangles. So are the numbers 3a, 4a, 5a and 5b, 12b, and 13b, where a and b are any two counting numbers. Find the smallest numbers for a and b so that the perimeters of the two triangles will be equal.

178. A man walked at a constant speed of 4 M.P.H. A car moving at a constant speed passed him. From the moment it that it passed him to its disappearance around the corner, the man took 18 steps and, walking on, reached the corner in 126 more steps. What was the speed of the car in M.P.H.?

179. Mrs. Green has a square garden 40 feet on each side. She wished to have cement walks laid along the diagonals, and presents the diagram shown to her gardener. AB = CD = DE = FG = GH = IJ = JK = LA = 2 feet. If it costs $4 a square foot to lay cement, what will it cost Mrs. Green for her cement walk?
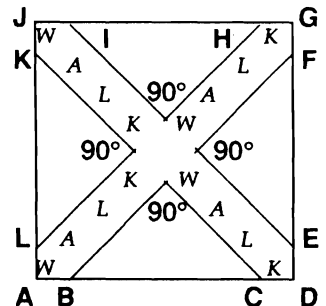
180. Car A and car B start together. Car A travels once around a circular track at 30 M.P.H. Car B travels in the opposite direction at 20 M.P.H. until he passes car A. From this point, at what speed must car B travel to finish once around the track at the same time that car A does?

181. Volume = area of base x height

A tank of water has a base of 6 square feet and a water height of .5 feet. A metal cube with a base area of 1 square foot and a height of 1 foot is placed on the bottom of the tank. How high will the water rise?
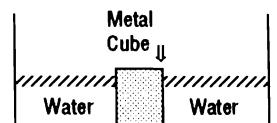
182. The numbers 2, 3, 5, 7, 11, 13, 17, 19, 23, 29..... are prime numbers. The length of each side of scalene triangle ABC is a prime number. Its perimeter is also a prime number. Find the smallest possible perimeter. (Remember that a side of a triangle _cannot_ be <u>larger</u> than or equal to the <u>sum</u> of its other <u>2</u> sides.)
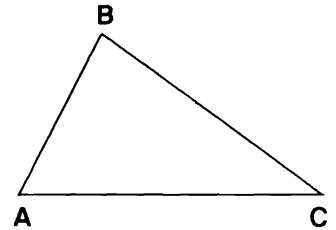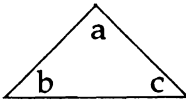
183. The figure represents an intersection of highway Ⓐ with streets Ⓑ and Ⓒ. Twenty percent (20%) of the traffic on Ⓐ turns onto Ⓑ and 25% turns onto Ⓒ. On Saturday, between 9 A.M. and 10 A.M., 300 cars came along highway Ⓐ. How many of these cars continued through the intersection?

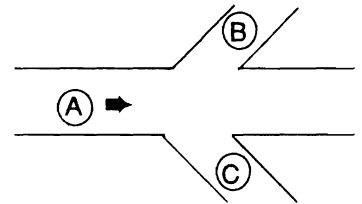184. Joe lives at the corner of a rectangular park $1\frac{1}{2}$ miles long by $\frac{1}{2}$ mile wide. Every day at 5:00 P.M. he leaves from the corner to jog once around the park. At 5:10 P.M. his neighbor also leaves from the same corner every day to jog once around, only in the opposite direction. If they pass each other at the opposite corner (half-way around) at 5:30 P.M., then the neighbor's jogging rate is _____ m.p.h. more than Joe's jogging rate.

185. An escalator in a department store moves down at the rate of 64 steps per minute. Julie can walk fast up ordinary steps at the rate of 96 steps per minute. In the store, there are 48 steps from one level to another. Julie decides to walk fast up the down escalator. How long will it take her to go up one level?

186. A number is said to be a "palindrome" if it reads the same from right to left as it does from left to right. Examples of palindromes are 14641, 2222, and 393. How many palindromes are there between 10,000 and 20,000?

187. Al and Bob each have a different number of baseball cards. They decide to "flip" a card. After each "flip", the loser must double the number of cards of the other person. After 4 "flips", Al lost the first two "flips" and won the last two "flips". Each boy now has 16 baseball cards. How many baseball cards did Al start with?

188. In bowling, a "handicap" is determined by subtracting your average bowling score from 180, then finding 80% of this difference. Sue bowls games of 120, 217 and 143. What is her "handicap"?

189. If two sides of a square field were 4 feet longer,* the field would contain 176 _more_ square feet of area. The area of the original square field is _____ square feet.

* as shown →

190. Find the smallest possible integer which when divided by either 3, 4 or 5 will have a remainder of 2.

191. The number 1125 has prime factors of 3's and 5's only (3x3x5x5x5). <u>How many</u> positive perfect square numbers other than 1 are factors of 1125?

192. Lou can walk the $2\frac{1}{2}$ miles to school at the rate of 6 m.p.h., or ride his bike at 12 m.p.h. One day he begins riding, but after $\frac{1}{5}$ of the way he gets a flat and has to walk his bike the rest of the way. This slows his walking rate _by_ one-third. How many minutes did it take Lou to get to school that day?

193. To organize a game, a teacher numbered her 27 students from 1 to 27. The game involves leaving the room when the teacher calls a number that is a factor of the student's tag number, and re-entering the room when another factor of the student's tag number is called. For example, student 6 leaves on 1, re-enters on 2, leaves on 3 and re-enters the room on 6. How many students are out of the room when all 27 numbers have been called?

194. If the symbol $\triangle$ with a on top, b bottom-left, c bottom-right $= a \times b - c$, find the value of (Express your answer in simplest form)
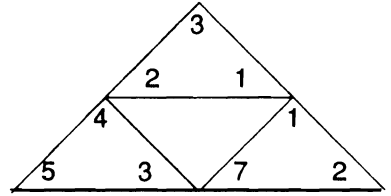
195. Mr. Lewis takes a train home every work day at 4:00 P.M. arriving at the station at 6:00 P.M. Every day, driving at the same rate, his wife meets him at the station and drives him home. One day he takes the train an hour early and arrives at the station at 5:00 P.M. His wife leaves the house to meet him at the regular time, so Mr. Lewis begins to walk home. She meets him along the way and they arrive home 20 minutes earlier than usual. How many minutes did Mr. Lewis walk?

196. Ross and Atacus, starting together, ran a 500 yard race, each running at a constant speed. When Ross crossed the finish line, Atacus was exactly 25 yards behind Ross. They decide to run the race again, this time Ross starting 20 yards behind the original starting line and each running at his same constant speed as before. This time _____ wins by _____ yards.

197. If $2 + 4 + 6 + 8 + 10 \ldots + 200 + 202 = 10,302$, find the sum of $4 + 8 + 12 + \ldots + 196 + 200$.

198. Six boy scouts on a camping trip discover that the amount of pancake mix they prepared for breakfast will make only one and one-half pancakes for each of them. For each of them to have exactly two pancakes, they must add enough mix to equal _____ the original amount.   a) $\frac{1}{2}$ b) $\frac{1}{3}$ c) $\frac{1}{4}$ d) $\frac{1}{5}$

199. The large rectangle at the right is divided into 5 congruent rectangles. If $x + y = 10$, find the area of the rectangular region labeled "A".
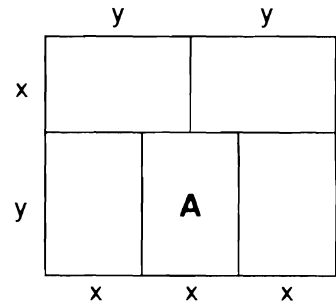
200. Hank has more money than Joe and Al combined. Joe has exactly twice as much money as Al. Al has more money than Steve. Hank has exactly four times as much money as Steve. None of the boys have more than 18¢. The total amount of money the four boys have is _____ ¢.

201. George has 2 quarters, 2 dimes and 2 nickels. Using at least one of the 6 coins, how many different amounts of money can he make?

202. A and B are two *different* digits. They represent these same two digits in the two-digit number AB, the reversed two-digit number BA, and a three-digit number A0B having zero for the middle digit. If AB subtracted from BA gives the same difference as BA subtracted from A0B, then what number is AB?

203. Lisa, Reneé and Donna are each wearing one ring. One of these rings is red, another is blue, and a third is green. The 3 girls are eating at a round table. Donna passes the salt to her right to the wearer of the green ring. Reneé passes the juice to the person on her right who passes it to her right to the wearer of the red ring. The color of each girl's ring is: Donna _____; Reneé _____; Lisa _____.

204. A parking garage charges $K for the first hour or fraction of an hour and $\frac{2}{3}K$ for each hour thereafter. Bill parked 7 times as long as Ray. If Ray parked for $\frac{1}{2}$ hour, Bill paid _____ times as much as Ray.

205. Ann and Betty, two cyclists, start at the same time. Ann starts at point A and Betty at point B, and travel towards each other at constant speeds **A** •→ ———— ←• **B**. They pass each other in 30 minutes and Ann, headed for point B, arrives there in another 20 minutes. In how many more minutes, *after Ann arrives at point B*, will Betty arrive at point A?

206. Isosceles $\triangle AOB$, where AO = AB, has a vertex angle of 100°. Point O is the center of a circle whose radius is 6. Find the area of the shaded region. (Your answer may be left in terms of π.)
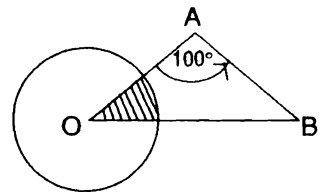
207. Turtle A and turtle B start from the same point and travel in opposite directions towards two bits of food. Both turtles reach their food in one hour. Turtle A's speed was 3 m.p.h. and turtle B's was 4 m.p.h. If each turtle had gone in the direction the other turtle took, turtle A would have reached the food _____ minutes after turtle B reached its food.

208. Al and Beth had a relay race against Chuck and Diane. They all move at constant speeds. Al goes half the distance at 4 ft./sec. and Beth the other half at 6 ft./sec. Chuck goes half the distance at 3 ft./sec. How fast must Diane travel the second half so that the race is a tie?

209. Train "A" is 200 ft. long. Train "B" is 400 ft. long. They run on parallel tracks each traveling at constant speeds. When moving in the same direction, "A" passes "B" in 15 seconds ₐ→ ᴮ→ ; ᴮ→ₐ→ . In opposite directions they pass each other in 5 seconds ₐ→←ᴮ ; ←ᴮₐ→ . How fast is each train moving? (use ft./sec.)

210. A man is digging a hole. He is 5' 10" tall. When we come upon him he tells us that he is $\frac{1}{4}$ done and, when he is finished, his head will be 3 times as far below ground as it is now above ground. How deep will that hole be when finished?

211. Tom and Burt are to take turns removing either 1 or 2 marbles from a circle. There are 7 marbles. The person selecting the last marble is the loser. If Tom goes first and each of them makes the best possible removals, then who will lose the game?

1.) (6) When looking at Mary compared to Jim, she picks up one brother (Jim) and loses one sister (herself). Or, assume 7 boys and 2 girls are in the family. Jim (one of the boys) has 6 brothers and 2 sisters. Mary has 7 brothers and only 1 sister.

2.) (156) Adding 1 through 12 and multiplying by 2 will give the correct total. The easiest way to count the 1 through 12 is to add 1 + 12, 2 + 11, etc. or 13 x 6 = 78. 78 x 2 = 156.

3.) (75) The shortest possible distance from Callicoon to Adams City will occur if Callicoon is between Adams and Biscayne. Under this condition Callicoon will be 75 miles from Adams City (107 – 32 = 75).

4.) (9 or 9¢) Joe can purchase 20 dozen doughnuts for $16.00 at 80¢ per dozen. (16.00 ÷ .80 = 20). There are 240 doughnuts in 20 dozen. The price charged for each doughnut, therefore is 9¢ (21.60 ÷ 240 = $.09 or 9¢).

5.) (3) To find the least number of people possible in one family, it is necessary to find the maximum number of people in the other 8 families. Eight (8) families can contain at most 48 people (8 x 6 = 48). Hence, there are at least 3 people in the remaining family.

6.) (20)

John	Bill	Difference
1	1	0
2	3	1
3	6	3
4	10	6
5	15	<u>10</u>
		20 total difference

7.) (c or $\frac{A+1}{B-1}$) A positive fraction increases in value when either its numerator gets larger or its denominator gets smaller. In this case, both situations exist. Therefore, $\frac{A+1}{B-1}$ has the largest value.

8.) (18) Bottle B holds 12 pints of water. When the contents of bottle A are poured into bottle B, bottle B is 3/4 full. Therefore, the contents of bottle A was 9 pints (3/4 of 12 is 9). Since bottle A contained 9 pints of water when it was 1/2 full, it will hold 18 pints of water when it is full.

9.) (2) When 5 people go from car 3 to car 2, there will be 10 more people in car 2 than cars 1 and 3 combined (car 3 loses 5, car 2 gains 5). When 7 people go from car 2 to car 1, there will be 4 more in cars 1 and 3 combined than in car 2. When 6 people get off the train it will leave 2 more in car 2 than in car 1 and car 3 combined.

10.) (30°) Angle A contains 30°, angle B contains 120° (30 x 4 = 120). Since the three angles must add to 180°, angle C must contain 30° (180 – 150 = 30).

11.) (20¢) 10 candy bars at 16¢ each would total $1.60. With only 8 candy bars to be sold, Mr. Brown would have to sell them at 20¢ each to receive $1.60.

12.) (13) The 13 are: Δ ABC, Δ BDG, Δ BGE, Δ ADF, Δ DGF, Δ GFE, Δ EFC, Δ BDE, Δ DEF, Δ ABF, Δ BFC Δ BFE, Δ BFD.

13.) (4) # – # = 0, so * must be 0. If * is 0, the C must be a 4 in the subtraction problem.

14.) (32) By doubling the number of people in each successive generation, there will be 32 people in the 6th generation.

Generation	1	2	3	4	5	6
No. of people	1	2	4	8	16	32

15. (96)   Since AH = 8, DE = 3, BC = 3, FG must equal 3. Since AB = 18, HG = 8, CD = 6, FE must equal 4. By extending lines FG and DE up to AB, the figure is divided into 3 rectangles of area 64, 20 and 12. Total area = 96.

16.) (115)   By Wednesday, Mike had 460 cards. Putting 460 cards into 4 equal stacks results in 115 cards in each stack (460 ÷ 4 = 115).

17.) (17)   Three times a teenager's age will result in a number between 39 and 57. Therefore, Carol's age must either be 14 or 15. (Reversing the digits will result in a number from 39 to 57). If Carol is 15, Bob is 17 and 51 is 3 times 17.

18.) (60)   If, when Lucy gave Ken 10 cards they had an equal amount, Lucy must have started with 20 more cards than Ken. Therefore, when Ken gave Lucy 10 cards, she would have 40 more cards than Ken. When looking for two numbers that are 40 apart where the larger is 5 times the smaller, 10 and 50 are the only two numbers that satisfy those statements. Therefore, Ken started with 20 cards and Lucy with 40 cards.

19.) (D)   Since A did not win, neither did B or E. Thus, either D or C won, but D came in 10 yards ahead of C; so D won.

20.) (7)   Any total larger than seven can be obtained using multiples of 3 and/or 5.

21.) (8)   Two "r" sections and one "t" section have a length of 20'. Since two "r" sections plus one "t" section plus one "y" section have a length of 28', the "y" section must have a length of 8 feet.

22.   (2)   Since 5 spoons and 2 glasses weigh as much as 3 plates and one plate weighs as much as one spoon and one glass, five spoons and two glasses weigh as much as three spoons and three glasses. Thus, two spoons weigh as much as one glass.

23.   (66)   Following the chart below:

No.	1	3	6	10	15	21	28	36	45	55
Skip	1	2	3	4	5	6	7	8	9	10
Next No.	3	6	10	15	21	28	36	45	55	(66)

24.   (60)   The two shaded rectangles both have a length of 12 and they have a combined width of 5 (12-7). Thus, their total area is 60 (5x12).

25.   ($72)   Since she had spent 7/8 of her money (1/2 + 1/4 + 1/8), she had 1/8 of her money left after shopping in the three stores. If $9 is 1/8 of her original money, she must have started shopping with $72.

26.   (1:38 P.M.)   Mr. Baxter must "make-up" 4 blocks. He "makes-up" one block every 2 minutes. Therefore, in 8 minutes he will catch up with Mr. Allen.

27.   (28)   The first woman plays 7 opponents. The second woman, 6 additional opponents, etc. 7+6+5+4+3+2+1 = 28.

28.   (7) $7 \times (8 \times 9 \times 10 \times 11 \times 12) = (7 \times 8 \times 9 \times 10 \times 11) \times 12$. However, (8x9x10x11x12) is greater than (7x8x9x10x11). By increasing the 7 by one, the result is one more (8x9x10x11x12) instead of one more (7x8x9x10x11).

29.   (5400) By producing a ball point pen every five seconds, the machine produces 12 pens each minute. Since she operates the machine $7 \frac{1}{2}$ hours daily, it produces $7 \frac{1}{2} \times 60 \times 12$ or 5400 pens.

30.   (9)   Since the three painters painted 2/3 of the house in 6 hours, they could have painted the whole house in 9 hours. Thus, one man, working alone, could have painted the whole house in 27 hours. He will, therefore, need 9 hours to paint the remaining 1/3 of the house.

31.   (6)   60 boxes are needed to pack 30,000 bananas (30,000 ÷ 500 = 60). Since 10 carts are needed to pack 60 boxes, 6 boxes are on each cart.

32.   (4)   0.....9 take up 10 spaces. That leaves 30 more spaces to be taken up by 15 2-digit numbers. 15 2-digit numbers starting with 10 ends with 24. The last digit is 4.

33.   (14)   If David won 3 times, then Allen must win 11 times to end up with 8 more cards than when he started. (3 + 11 = 14).

34.   (97)   81 means 8 dozen 1 egg or 8 x 12 + 1 = 97.

35.   (13)   If each sheep had 2 feet, then the total number of feet would be 34 (17 x 2 = 34). The extra 26 feet (60 – 34) is determined by the additional 2 legs for each sheep. 26 ÷ 2 = 13. He has 13 sheep and 4 chickens.

36.   ($3 or 3)   Since six people paid $8 and three people paid $4.25, three people had to pay $3.75. Thus, each additional person paid $1.25. Subtracting $1.25 from $4.25 (the charge for 3 people) leaves $3 as the fixed charge for the driver and one passenger.

37.   (6)   The numbers 1, 2, 6, and 9 can determine the other measures in the following manner: 3 = distance from 6 to 9; 4 = distance from 2 to 6; 5 = distance from 1 to 6; 7 = distance from 2 to 9; 8 = distance from 1 to 9.

38.   (210)   Alex gains 1/2 yard every second, so it will take him 60 seconds to overcome the 30 yard lead. Since he finishes 2 seconds ahead of Bob, he has a 5 yard lead at the finish. It would take him 10 seconds to gain 5 yards on Bob. In all, Alex ran for 70 seconds (60 + 10). 3 x 70 = 210 yards.

39.   (3)   By adding one pound to the scale, 2 small blocks plus that one pound would equal a large block. Do this again and the equivalent of 4 large blocks would weigh 28 pounds (26 + 2). A large block, therefore, weighs 7 pounds and a small block 3 pounds.

40.   (6)   Two black beads with 6 white beads at the left, and one black bead with 3 white beads at the right will result in 1/4 of the beads on each side being black.
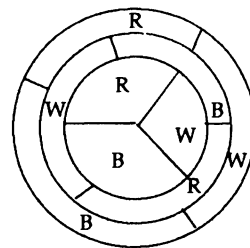
41.   (3)   R = Red; B = Blue; W = White

42.   ($1.19)   For each kind of coin, Rick can have at most: 1 half-dollar, 1 quarter, 4 dimes, 1 nickel, and 4 pennies. All these can be used except the 1 nickel. They make up the 10 coins (.50 + .25 + .40 + .04 = $1.19).

43.   (1 or 1:00 P.M.)   The faster watch gains 4 minutes every 2 hours. It will take 30 hours to gain 60 minutes. In 30 hours it will be 1:00 P.M.

44.   (42)   Since all 3 children weigh 174 pounds and Carlos and Peggy weigh 121 pounds, Gina must weigh 53 pounds (174 - 121 = 53). Since Peggy and Gina weigh 95 pounds together, Peggy must weigh 42 pounds (95 - 53 = 42).

45.   (7)   Substitute 5 plums and 1 apple for 1 pear. This will give 3 apples and 5 plums balancing 11 plums. Therefore, 3 apples balance 6 plums, or 1 apple balances 2 plums. Since 5 plums and 1 apple balance 1 pear, then 7 plums will also balance 1 pear.

46.   (11)   The first bag contains 50 - (2nd & 3rd + 4th & 5th) or 50 - (20 + 27) = 3. The fifth bag contains 50 - (1st & 2nd + 3rd & 4th) or 50 - (21 + 21) = 8.   3 + 8 = 11.

47.   ($90)   Since he received $30 and the radio for 10 mowings, he should receive $120 for the remaining 10 mowings ($150 - $30). For 20 mowings he should receive $240. The value of the radio, therefore, is $90 ($240 - $150).

48.   (10)   The hop is 1, the skip is 3, and the jump is 6 (1 jump = 2 skips = 6 hops). 1 + 3 + 6 = 10.

49.   (Kim) If Jim took the cookies, then all of them told the truth. If Tim took the cookies, then all of them lied. If Kim took the cookies, then Kim and Jim lied, but Tim told the truth.

50.   (12)   Every four 3-foot boards will equal three 4-foot boards in length. The total number of boards will be a multiple of 7. There are a total of 21 boards. Therefore, there are twelve 3-foot boards and nine 4-foot boards.

51.   (18)   Going, 15 people took the bus and the remaining 15 people went by car. Since 5 people rode in each car, there were 3 cars. Coming back, 12 people rode in the 3 cars and 18 (30 – 12) came home by bus.
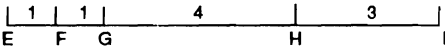
52.   (40 minutes) Count each science question as 2 units. 2 x 40 = 80. In terms of time, the science questions represent $\frac{80}{360}$ or $\frac{2}{9}$ the total time. Since 3 hours = 180 minutes, $\frac{2}{9}$ x 180 = 40 minutes. (Counting each science question twice represents 360 questions.)

53.   ($13\frac{1}{3}$ or equivalent)   In 40 minutes, Cindy completes 8 laps to Alice's 5 laps, and is 3 laps ahead. Therefore, in $\frac{1}{3}$ x 40 = $13\frac{1}{3}$ minutes Cindy will be one lap ahead.

54.   (8)   C must be 2. B must be 6 since 3 x B = – – 8. Since C is 2, A must be 4, since 8 + 8 has a unit's digit of 6. Now, 43 x 62 = 2666. D + E = 2 + 6 = 8.

    ```
        A 3
      x B C
      -----
        - -
      - - 8
      -----
      D E 6 6
    ```

55.   (15)   Multiples of 5 end in a zero or a 5. To add to 99 shirts, the multiple of 12 must end in a 4 or a 9. The multiples of 12 to test are 24 and 84. 84 + 15 = 99. 7 box "B" and 3 box "A". This is not more than 10. 24 + 75 = 99. 2 box "B" and 15 box "A".

56.   (GH = 4)   (HI = 3)

    EF = 1, EG = 2, HI = 3, GH = 4, FH = 5, EH = 6, GI = 7, FI = 8, EI = 9.

57.   (8)   In sequence; AxB = B so A = 1. BxC = 1C so B = 3, C = 5. 5xD = 35 so D = 7. 7xE = 5H so E = 8 and H = 6. (If BC = 1C and B = 6, C = 2 is chosen, it fails to meet the criterion of the next step.)

58.   (72) $128 \div 8 = 16$. The area of each square is 16 square feet. Each side of the square is 4 feet. The perimeter is $18 \times 4 = 72$ feet.

59.   (40)   The minute hand is $6 \times 6 = 36$ units behind the hour hand. Every 10 minutes the minute hand gains 9 units on the hour hand. In 40 minutes it will gain 36 units.

60.   (0)   Since $5 \times 2 = 10$, any number times 10 will have a zero for the unit's digit.

61.   (1) $S = 3 + 1 + 0 + 4 + 3 = 11$. When 11 is divided by 5, the remainder is 1.

62.   (18)   From the 1st row take 3 and 4; 2nd row take 3; 3rd row take 1 and 4th row take 4 and 3. $3 + 4 + 3 + 1 + 4 + 3 = \$18$.

63.   (99)   The next number where the digits read the same forward or backward would be 70907. (Such a number is called a palindrome.) $70808 + 99 = 70907$.

64.   (23)   As the train leaves station ⓧ, there are 11 trains from station ⓨ on the way. 12 more trains will leave station ⓨ before the train from ⓧ arrives. $11 + 12 = 23$.

65.   The sum of the first six numbers is 43 x 6 = 258. The sum of all eight numbers is 51 x 8 = 408. The two new numbers add to 150 (408 - 258) so their average is 75 (150 ÷ 2).

66.   (20)   Liz has 5 blank spaces (Tom had 3 more blank spaces than Liz). If Liz has 5 blank spaces, then she has 20 covered spaces.

67.   (27¢)   The pen could cost from 24¢ to 27¢ to meet the required conditions. If the pen were to cost 28¢, Jim would have 4¢ (to be 24¢ short); and now Barbara's money plus Jim's 4¢ would be enough to buy the pen.

68.   (6)

Age Now		Age in 1 Year	
Janet (yrs.)	Dog (mos.)	Janet (yrs.)	Dog (mos.)
3	1	4	13
6	2	7	14

69.   (6)   The second teacher closes 6 of the 12 doors. The third teacher will close 2 doors and open 2 doors so that 6 of the 12 doors are still open. (Feel free to explain to your class why teachers have nothing else to do but open and close doors.)

70.   (Baker)   Mr. Baker is not the baker. Mr. Carpenter is not the baker since his wife is the baker's sister. Therefore, Mr. Plumber is the baker.

71.   (11)   Find the least common multiple of 2, 3 and 4. This is 12. One less than a multiple gives the largest possible remainder. 12 - 1 = 11.

72. (7) 96 - 12 = 84 wagons. 84 people were transferred from 12 wagons. 84 ÷ 12 = 7. There were 7 people on each wagon originally.

73. (144) If a side of the square were the same length as a side of the triangle, then the 66 cm. would be divided into 7 pieces (4 for the square, 3 for the triangle). Instead, the 66 cm. should be divided into 11 pieces (4 + 4 + 3) since the length of a side of the square is twice that of the triangle. Therefore, each side of the square is 12 cm. and each side of the triangle 6 cm. (12 x 4 + 3 x 6 = 66). The area of the square region is 12 x 12 = 144 sq. cm.

74. (7) There are 3 possible ways of arriving at 7. The simplest is: 2 with perfect sight, 1 blind only in the right eye and 4 totally blind. (The other two possibilities are reached by starting with 3 totally blind and then 2 totally blind.)

75. (4) 78 + 87 = 165; 165 + 561 = 726; 726 + 627 = 1353; 1353 + 3531 = 4884.

76. (15) On the face of a clock, the **difference** between the numbers opposite one another is always 6 (1/2 of 12). In this case, the difference between the numbers opposite one another will always be 9 (1/2 of 18). Since 15 - 6 = 9, 15 is opposite 6.

77. (6009) It must be after 2000. The smallest digit for the thousand's place is 6. Then 9 must be in the unit's place. Place two zeros in between to get the next year after 1961.

78. ($2) In 8 games it will be 4 minutes before he is knocked out. 8 x .25 = $2.00

79. (19) There are 9 two-digit palindromes. The palindromes between 100 and 200 are of the form 1A1, where "A" could be any one of the ten digits. 9 + 10 = 19.

80. (ab = 27; cd = 54) The remaining digits are 2, 4, 5 and 7. The fraction must equal $\frac{1}{2}$. Thus, the numerator must be 24, 25 or 27. $\frac{27}{54} = \frac{1}{2}$.

81. (Richard) Richard is shorter than John since he is John's older brother. Mike is shorter than Richard since he is older then Richard. Henry is shorter than Mike. From tallest to shortest: John, Richard, Mike, Henry.

82. (12) $^{21}\diagdown_3{}^6 = 21 - (6 \times 3) = 21 - 18 = 3.$ $^{30}\diagdown_7{}^3 = 30 - (3 \times 7) = 30 - 21 = 9.$ 9 + 3 = 12.

83. (5) There are 60 balloons (20 x 3). Since 10 students take 10 balloons, the remaining 10 students can share the remaining 50 balloons. Each will get 5 balloons.

84. (9) The difference between 42 and 24 is 18. If Debbie gives up 9 marbles and Chris gains 9 marbles, they will have the same number of marbles (42 – 9 = 33, 24 + 9 = 33).

85. (1 quarter and 2 pennies) Together Phil and Paul have 73¢ (Phil has 63¢ and Paul 10¢). Phil must end up with 36¢ and Paul 37¢ in order for Paul to have 1¢ more than Phil. Therefore, Phil gave Paul 27¢ (63 – 36 = 27) in 3 coins. 1 quarter and 2 pennies = 27¢.

86. (70) Once around the track is 810 ÷ 3 = 270 meters. 80 + 50 = 130 meters. 270 – 130 = 140 meters for the distance from A to B and from C to D. Therefore, the distance from A to B is 140 ÷ 2 = 70 meters.

87. (1)

50	25	10	5
1		2	6
	2	3	4
1	**7**	**1**	

88. (77¢) All 3 together cost $2.65. One hamburger and one cola cost $2.10 ($4.20 ÷ 2). Therefore, the french fries must cost $ .55 ($2.65 – $2.10). Since one french fries and one cola cost $1.32 ($2.64 ÷ 2) and the french fries are 55¢, then the cola must cost 77¢ ($1.32 – .55).

89. (4^1/₂ lbs. or 4 lbs. 8 oz.)   One-third of the water weighs 2^1/₂ lbs. (12 – 9^1/₂). The water originally in the container weighed 7^1/₂ lbs. (3 x 2^1/₂). The container, therefore, weighs 12 – 7^1/₂ = 4^1/₂ lbs.

90. (15)   Jill will run 3 yards for every 4 yards Alice runs. When Alice runs 60 yards (4 x 15), Jill will run 3 x 15 or 45 yards. Therefore, Jill will be 15 yards behind Alice at the end of the race.

91. (2^1/₂) The 4 large cubes weigh the same as 12 small cubes, so 20 small cubes (8 + 12) weigh 10 pounds. Each small cube weighs ^{1}/₂ pound and each large cube 1 ^{1}/₂ pounds. Two small cubes plus 1 large cube weigh 2 ^{1}/₂ pounds.

92. (1549) For 3 digits appearing in the hundred's place, 3, 5 and 7 will yield the greatest sum. Therefore, A = 1. Since T appears most often in the unit's place, let T = 7, B = 5 (B appears once in the unit's place), and let R = 3. 317 + 517 + 715 = 1549.

93. (567) ① T must be 7. ② S must be 6 since 6 + 8 = 14. R must be 5, carry the 1, then 6 + 9 + 1 + R = 21, R = 5.

```
        ①                ②
       R S 7            R 6 7
     x 7 4 1          x 7 4 1
     --------         --------
        - - 7            - 6 7
      - - - 8            - 6 8
    - - - 9              9
     --------         --------
      1 4 7              1 4 7
```

94. (9)   It takes her 5 minutes, or 1/12 of an hour, to ride 3/4 of a mile. In one hour she can ride 12 x 3/4 = 9 miles. The 15 minutes to walk to the repair shop is not needed.

95. (195)   Since Rebecca ran 150 yards, had a 30-yard headstart, and lost to Laura by 15 yards, Laura must have run 150 + 30 + 15 or 195 yards.

96. (5)

	1	2	3	4	5

OOO → OOC → OCC → OCO → CCO → CCC

97. (4)

Name	Times past starting point each minute	Passes starting point every _____ second
Al	20	3
Bob	12	5
Carl	4	15
Don	8	7.5

From the chart above, all participants pass the starting point every 15 seconds. Thus, they will pass it together 4 times every minute.

98. (360)   There are 5 choices (2, 3, 4, 5, 6) for the hundred's place, 9 remaining choices for the ten's place and 8 remaining choices for the unit's place. 5 x 9 x 8 = 360.

99. (42)   20 numbers are eliminated the first time (multiples of 5 through 100). 20 numbers are eliminated the 2nd time. By the 3rd time, 103 has reached 105 and 21 numbers are eliminated. 103 − 61 = 42 numbers remain.

100. (11 or 11:00 A.M.)   Beth flew 3 hours, arriving in Chicago 8:00 P.M. New York time or 7:00 P.M. Chicago time. Joanne arrived in Chicago 7:00 P.M. Chicago time and, therefore, left Los Angeles 1:00 P.M. Chicago time or 11:00 A.M. Los Angeles time.

101. (107)   From 12:00 noon until 3:33 P.M. is 3 hours and 33 minutes, or $180 + 33 = 213$ minutes. The first 9 pages take 9 minutes. There are 90 pages (10 – 99) that contain 2 digits. They take 180 minutes. $213 - 189 = 24$ minutes left. Therefore, there will be 8 pages containing 3 digits each (100 - 107). There are 107 numbered pages in the book.

102. (13)   If the counselor gave each boy 5 apples, he would have 15 apples left over (5 from the boy who did not want any plus 10 he had left over). After giving each boy 1 additional apple he has 3 left over. Therefore, 12 boys received apples and 1 boy did not. There were 13 boys total.

103. (3)

	1	2	3	4	5	6	7	8
A	7	4	9	6	11	8	13	10	15
B	6	11	8	13	10	15			

It takes B 3 fewer moves to reach 15.

104. ($7.00 or 7)   If seven pumpkins cost $15.00 and ten pumpkins cost $21.00, the extra three pumpkins must cost a total of $6.00 and thus sell for $2.00 each. Since each additional pumpkin sells for $2.00, four pumpkins sell for $8.00 and the fixed price of the first three pumpkins is $15.00 − $8.00 or $7.00.

105. (20 or $2^2 \times 5$) $K \times 2^3 \times 5^4 = 10^5$ and $10^5 = 2^5 \times 5^5$, $K = 2^2 \times 5$ or 20. Also $2^3 \times 5^4 = 8 \times 625$ or 5000 and $10^5 = 100,000$ and, again, $K = 20$.

106. (5, 6, 7, 8, 9, 10, 11, 12, 13)   A suggestion for solving a problem of this type is to start with the perfect square about which the other numbers are symmetric.

107. (49)   By examining each perfect square, in order, above 4 the first case in which <u>both</u> requirements are fulfilled is 49. (48 is a multiple of 3 and 50 is a multiple of 5.)

108. (96)   Since each math question takes twice as much time as each question of other types, we could say that the test is broken into 250 parts instead of 200 parts [150 + (2 x 50)]. Of the 250 parts, 100 (50 questions at twice the time) are in mathematics. Thus $\frac{100}{250}$ or $\frac{2}{5}$ of the test time should be devoted to the mathematics questions. $\frac{2}{5}$ of 240 minutes (4 hours) is 96 minutes.

109. (2:30 or 2:30 P.M.)   Since Tour A leaves at 1:30 P.M., it will pass the waterfall at 2:45 (halfway through the 2 ¹/₂ hour tour). In order for Tour B to pass the waterfall at 2:45 P.M. it must leave at 2:30 P.M. Since it passes the waterfall 15 minutes after the beginning of the tour (¹/₄ of the way through the hour tour).

110. (4)   By starting all diagonals from the same vertex the hexagon can be divided into a minimum of 4 triangles.

111. (66) Of the 100 seats in the row, 12 are occupied by the people and 22 are in the space between each pair of people (11 spaces x 2 seats per space). This accounts for 34 seats. Thus, there are 66 seats (100 – 34) that are not between any two of the people.

112. (76) The opposite sides of a rectangle are equal, thus, $4x = 3y$. There are 7 congruent rectangles all of area 48 ($\frac{336}{7} = 48$). $xy = 48$ and $y = \frac{4}{5}x$. Substituting $x(\frac{4}{3}x) = 48$; $\frac{4}{3}x^2 = 48$; $x^2 = 36$; $x = 6$ and $y = 8$. The perimeter is $6x + 5y = 6(6) + 5(8) = 76$.

113. (2) One fourth of the area of the shaded region $= \frac{1}{4}$ area of the circle – the area of the right triangle $\frac{1}{4}(\pi - 2) = \frac{1}{4}\pi x^2 - \frac{1}{2}x^2$; $\pi - 2 = \pi x^2 - 2x^2 = x^2(\pi - 2)$; $x^2 = 1$ and $x = 1$.
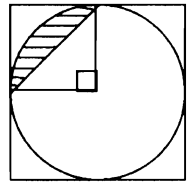
114. (12) Triangles AGE and CHE are congruent by AAS or ASA. The sum of the areas of the triangles AGE and DEH is equivalent to the area of triangle DEC which is 12. $(\frac{1}{2}(12)(2))$ DC = 12 and the height $= \frac{1}{2}$AD.

115. (50 or 50%) If $\frac{d}{t}$ is the rate of the old train, then the rate of the new train is $\frac{1.2d}{.8t}$ or $\frac{3}{2}\frac{d}{t}$. The new train's rate is $\frac{1}{2}\frac{d}{t}$ greater than the old train's or 50%.

116. (2.50 or $2.50) If x equals the sale price then $1.60 = x - .2x$ and $x = \$2.00$. If y is the list price then $y - .2y = \$2.00$ and $y = \$2.50$.

Solutions

117. ($\frac{4}{3}$)   Diagonals $\overline{HK}$, $\overline{GJ}$, $\overline{IL}$ will meet at point P forming 6 equilateral triangles from the regular hexagon HGLKJI. The entire star consists of 12 congruent equilateral triangles and the original triangle ABC consists of 9 congruent equilateral triangles. Thus, the ratio is $\frac{12}{9} = \frac{4}{3}$.
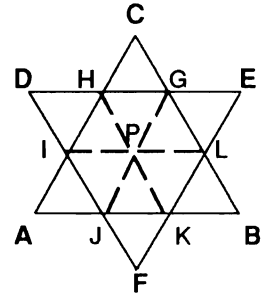
118. (47)   The numbers are 2, 12, 22, 32, 42, 52, 62, 72, 82, 92. The outside pair (2 & 92) have an average of 47. The next pair (12 & 82) have an average of 47, etc. Since there is an even number of members in the set, the average of the entire set is also 47.

119. (325)   She needs 25 seconds to run the first 200 meters ($\frac{200}{8} = 25$) and 100 seconds to walk the next 200 meters ($\frac{200}{2} = 100$).
The first 400 meters, therefore, require 125 seconds, the next 400 meters require another 125 seconds. The next 200 meters (running) require 25 seconds and the final 100 meters (walking) requires 50 seconds. A total of 325 seconds (125 + 125 + 25 + 50) is needed to travel the 1100 meters.

120. (2/3)   A lawn 120 feet by 80 feet has an area of 9600 square feet. After mowing around the uncut portion twenty times, the remaining area would be 80 feet by 40 feet or 3200 square feet. Therefore, 6400 square feet or 2/3 of the lawn had been mowed.

121. (9)   With a combined score of 70 points and the Port Royal team winning by 2 points, the score of the game was 36 to 34. In the first quarter the Port Royal team scored 1/3 of 36 or 12 points, in the second quarter 1/4 of 36 or 9 points, and in the third quarter 1/6 of 36 or 6 points. Therefore, the team scored the remaining 9 points in the fourth quarter.

122. (8)   Each shaded region is a parallelogram having a base of 1 and a height of 4. Thus, each region has an area of 4. The total shaded area is 8.

123. (2:40 P.M.) $221 \div 34 = 6\frac{1}{2}$; thus, the actual travel time is 6 hours 30 minutes. Add to this the ten 4-minute stops and the total is 7 hours 10 minutes. Therefore, the train arrives at its final destination at 2:40 P.M.

124. (450)   Since one carrier can deliver 75 newspapers in 2 hours, 4 carriers could deliver 300 newspapers in 2 hours. Four carriers could deliver 150 newspapers in 1 hour and 450 newspapers in 3 hours.

125. ($\frac{1}{8}$)   If the radius of the small circle is k, then the radius of the large circle will be 2k. The ratio of the area of the small circle to that of the large circle is $\frac{\pi k^2}{\pi(2k)^2}$ or $\frac{1}{4}$. Thus the ratio of the area of the shaded region (half the smaller circle) to that of the large circle is $\frac{1}{8}$.

126. (16%)   20% of 4 liters = .8 liter, so there is .8 liter of milk in the original mixture. In the new mixture of 5 liters there is still .8 liter of milk. $\frac{.8}{5} = 16\%$.

127. (2 ft.)   Since the radius of the large circle is 6 feet, its circumference is 12πft. Thus, the circumference of the small circle is 4πft. making its radius 2 feet.

128. (b or 125%)   If each edge is increased by 50%, an edge k units long would be increased to $\frac{3}{2}$ k units. Thus, the new (larger) surface area will be $6(\frac{3}{2}k)^2$ or $\frac{27k^2}{2}$ whereas the surface area of the original (smaller) cube was $6k^2$. The increase in area was $7.5k^2$ or 125% of the original area.

129. (3 or equal)   After both transfers of milk and coffee were made, there is some coffee in the milk. That coffee is replacing milk. That milk (that is being replaced) must be in the coffee.

130. $(4\sqrt{3})$ BD = DE = 2. HE = 4. HD = $2\sqrt{3}$ by the Pythagorean property. Thus, the area of the rectangle is $4\sqrt{3}$.

131. (13) $2, 2\frac{1}{8}, -----, 3$ would be 9 marks. Additionally, $2\frac{1}{6}, 2\frac{1}{3}, 2\frac{2}{3}$ and $2\frac{5}{6}$ would be needed.

132. (48)   Every 12 minutes the minute hand gains 11 units on the hour hand. In 48 minutes (4 x 12), it would have gained 44 units (4 x 11) and be one unit behind the hour hand.

133. (60)   At 11:00 A.M. Joan will be at the checkpoint while Sue will be 20 miles behind (at 10 M.P.H. she passes the checkpoint 2 hours later). It will take Joan 4 hours to be 20 miles ahead of Sue, since she is traveling 5 M.P.H. faster. In 4 hours Joan has travelled 60 miles.

134. (3)   Since E is less than 10, A = 1 or 2. Since 4D is even, A = 2. Then, D = 3 or 8. Either way, we carry an odd number to the tens place making E = 9. If D = 3 we are led to a dead end. Thus, D = 8; carry 3 to the tens place forcing C to be 4 (4x4+3 = 19). We carry 1 to the hundreds place forcing B to be 3 (4x3+1 = 13).

135. (Monday)   In 100 years there will be a rotation of 125 days (100 + 25 extra). 125 ÷ 7 = 17 remainder 6. Six days after Tuesday is Monday.

136. (4)   Since a "Druid" and a "Meef" weigh 7 pounds while a "Druid" and a "Zarp" weigh only 4 pounds, a "Meef" must weigh 3 pounds more than a "Zarp". So, if two "Meefs" and a "Zarp" weigh 9 pounds, 3 "Meefs" would weigh 12 pounds or one "Meef" 4 pounds.

137. (80)   On the first day he took 20 steps (one step per second and took 20 seconds). The next day he took 32 steps (2 steps per second and took 16 seconds). The difference of 12 steps must be equalized by the difference of 4 seconds. This means that the rate of the escalator must be 3 steps per second. $3 \cdot 20 + 20 = 80$ or $3 \cdot 16 + 32 = 80$.

138. (20)   Let x = the number of feet the tree grows each year. At the end of the fifth year it is $10 + 5x$ feet high. During the sixth year it grows $\frac{10 + 5x}{11}$ feet. Thus, $\frac{10 + 5x}{11} = x$; $x = 1\frac{2}{3}$. $6 \times \frac{5}{3} = 10$ feet. $10 + 10 = 20$.

139. ($37\frac{1}{2}$ or $37\frac{1}{2}$%)   3 pints blue + 1 pint yellow = 4 pints green.
    2 pints red + 2 pints yellow = 4 pints orange.
    Thus, 3 of the 8 pints are yellow. $\frac{3}{8} = 37\frac{1}{2}$%

140. (240)   Alan gains $\frac{1}{2}$ yard every second, so it will take him 70 seconds to overcome the 35 yard lead. Since he finishes 2 seconds ahead of Bill, he has a 5 yard lead at the finish. It would take him 10 seconds to gain 5 yards on Bill. In all, Alan ran for 80 seconds (70 + 10). $3 \times 80 = 240$.

141. (2-0)   Each follow logically: England played 3 games. England lost to Scotland 3-0. (That is their loss and all goals scored against.) England ties Wales 0-0. (That is their tie.) England beat Ireland 2-0. (That is their win; no goals scored against.)

142. (6)   In sequence; $A \times B = B$ so $A = 1$. $B \times C = 1C$ so $B = 3$, $C = 5$. $5 \times D = 35$ so $D = 7$. $7 \times E = 5H$ so $E = 8$ and $H = 6$. (If $BC = 1C$ and $B = 6$, $C = 2$ is chosen, it fails to meet the criterion of the next step.)

143. (963) C must be 3.

	3	63	963
	x 321	x 321	x 321
	3	63	963
	6	26	26
	9	9	9
	3	23	123

144. (18) Since it took Al 12 minutes to overtake Chuck (made up 400 yards), he is halfway (200 yards) in the 6 minutes it took to overtake Bill. Bill has, therefore, gained 100 yards on Chuck in 6 minutes. It will take Bill 3 x 6 or 18 minutes to gain 300 yards.

145. ($\frac{2}{15}$) Mr. X and Mr. Y own $\frac{2}{5}$ of the motel together. Since Mr. Y owns twice as much as Mrs. Z, divide the $\frac{2}{5}$ into 3 equal shares. Therefore, one of those shares (or the part Mr. Z owns) is $\frac{2}{15}$ of the motel ($\frac{1}{3}$ of $\frac{2}{5} = \frac{2}{15}$).

146. (264) Length of train = 88 x 3 = 264. At 88 feet per second it took 3 seconds to pass the entrance to the tunnel. The rest of the information in the problem is superfluous.

147. (1924; 7) Find the number less than 31 with the most divisors. 1/24/24; 2/12/24; 3/8/24; 4/6/24; 6/4/24; 8/3/24; 12/2/24.

148. (5) Clock "B" gains $2\frac{3}{5} = \frac{13}{5}$ minutes each day. It must gain 13 minutes. $13 \div \frac{13}{5} = 5$.

149. (36) A point that can be reached from <u>2</u> other points by going right or down adds the numbers of these points. A point reachable from one point, keeps the same number.
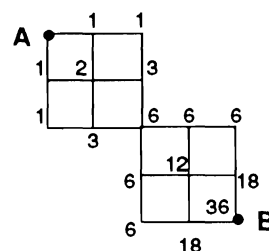
150. (6) $4^1 = 4$, $4^2 = 16$, $4^3 = 64$, $4^4 = 256$. Notice that if 4 is raised to an odd power the unit's digit is 4 and if raised to an even power the unit's digit is 6. Since 478 is even, the unit's digit is 6.

151. (19) The number must leave a remainder of 4 when divided by 5: 9, 14, 19, 24, etc., and a remainder of 3 when divided by 4 (if Bob was on the same step as Tom the remainder would be 1): 7, 11, 15, 19, 23, etc. The smallest number is 19.

152. (6) Let x = number sold.

To be sold	# Sold	Left over
10	x	$10 - x$
$20 - 2x$	x	$20 - 3x$
$60 - 9x$	x	$60 - 10x = 0$
		$x = 6$

153. (50) After 10 miles, one car can transfer a gallon to each of the other cars and return. After another 10 miles, a second car can do the same and so on. The fifth car loaded up goes the last 10 miles and returns. $10 + 10 + 10 + 10 + 10 = 50$ or; the car started with 6 gallons and received 1 gallon from each of the other 4 cars. It can travel 50 miles out and still return.

154. (50) The whole class scored 2100 points. Those who passed scored 1600 points. Thus, those ten who failed must have scored 500 points. $500 \div 10 = 50$.

155. $\left(\frac{9}{4}\right)$ Rate is distance ÷ time. The ratio of Hank's rate to Joe's rate is $\frac{3}{2}$ $\left(\dfrac{\frac{d_1}{8}}{\frac{d_1}{12}}\right)$. The ratio of Al's rate to Joe's rate is $\frac{2}{3}$ $\left(\dfrac{\frac{d_2}{12}}{\frac{d_2}{8}}\right)$

Therefore, the ratio of Hank's rate to Al's rate is $\frac{3}{2} \div \frac{2}{3} = \frac{9}{4}$.

156.   (41,325)   24 start with each of 1, 2 and 3 for the first 72 (24 x 3) of these ordered numbers. The 75th number must be the third number starting with 4. 41,235; 41,253; 41,325.

157.   (8)   At point E, John has run 550 yards to Tom's 330 + 30 = 360 yards; or 55 yards for every 36 yards. When John runs 110 yards more (2 x 55), Tom will run 72 yards (2 x 36). 360 + 72 = 432. Tom is 8 yards behind John.

158.   ($4\frac{1}{2}$ mi.)   Since the rate of the bus is $\frac{2}{3}$ the rate of the train, every mile the bus travels, the train travels $1\frac{1}{2}$ mi. The train gains $\frac{1}{2}$ mile for every mile by the bus. Since the train route is $1\frac{1}{2}$ mile longer, the bus must travel 3 miles to arrive at the same time as the train. Thus, the train route is $4\frac{1}{2}$ miles.

159.   (48)   Each can receives $3 \times \frac{1}{12} = \frac{1}{4}$ of a filled box of marbles. Each box loses $6 \times \frac{1}{12} = \frac{1}{2}$ of a filled box. Each box has $\frac{1}{2} - \frac{1}{4} = \frac{1}{4}$ of a filled box <u>more</u> than each can. Therefore, 12 marbles represents $\frac{1}{4}$ of a filled box. A filled box contained 4 x 12 = 48 marbles at the beginning.

160.   ($2\frac{1}{2}$) $\frac{33 \text{ feet}}{9 \text{ sec.}} \left(\frac{1 \text{ mile}}{5280 \text{ feet}} \right) \left(\frac{3600 \text{ sec.}}{1 \text{ hour}} \right) = 2\frac{1}{2}$ mile/hour.

161.   (26)   There are 8 where the ten's digit and unit's digit are 6, not counting 666. There are 9 where the hundred's digit and the ten's digit are 6, not counting 666. There are 9 where the hundred's digit and the unit's digit are 6, not counting 666. 8 + 9 + 9 = 26.

162.   (21)   Between 2 cities there is one line. Between 3 cities add 2 for a total of 3 lines. Between 4 cities add 4 more for a total of 7 lines . . . 7 cities add 6 more. 1 + 2 + 3 + 4 + 5 + 6 = 21.

163. $(\frac{2X+3Y}{5})$ Since the average of A and B is X, A + B = 2 X. Similarly, C + D + E = 3 Y. The average of the 5 numbers A, B, C, D and E therefore, is $(\frac{2X+3Y}{5})$.

164.   (64)   Since the cardboard has an area of 80 square inches and is made up of 5 congruent squares, each square must have an area of 16 square inches. Thus, each square has sides 4 inches long. The box will be a cube having edges 4 inches long and will, therefore, have a volume of 64 cubic inches.

165. $(\frac{7}{24})$ $\frac{1}{3} = \frac{4}{12}$; $\frac{1}{4} = \frac{3}{12}$. The mixture will contain 24 parts of which 7 are pure orange juice.

166.   (25π)   ED = 6, DF = 8. By the Pythagorean Theorem, EF = 10. The radius of circle O is 5 and the area of circle O is 25π (A = πr²).

167.   (8)   2 4 6 8 10 12 14 16 .   There are 8 houses.

          30   30

168.   ($67.20)   The number of each kind must be the smallest number divisible by 8, 7 and 6. 8 x 7 x 3 = 168. 168 nickels = $8.40, 168 dimes = $16.80 and 168 quarters = $42.00. $42.00 + $16.80 + $8.40 = $67.20.

169.   (34)   Since two apples and three bananas cost 33¢, four apples and six bananas would cost 66¢. Four apples and seven bananas cost 71¢, so one banana costs 5¢. Thus, one apple costs 9¢. Therefore, one apple and five bananas cost 9¢ + 25¢ = 34¢.

170. (256) $121 \to 4; 144 \to 9; 169 \to 16; 196 \to 16; 225 \to 9; 256 \to 13$ (not a perfect square).

171. (1089) If the product of a 4 digit number times 9 is a 4 digit number, the thousand's digit must be a 1. The hundred's digit must be a 0, so that nothing carries to the thousand's place.

$$
\begin{array}{cccc}
1\,\square\,\square\,9 & 1\,0\,\square\,9 & 1\,0\,8\,9 \\
1\quad\quad 9 & \quad 9 & 9 \\
\hline
9\quad\quad 1 & 9\quad 0\,1 & 9\,8\,0\,1 \\
\end{array}
$$

172. (10) It will take the man 60 minutes to reach the crossing (he is 6 miles away and traveling at 6 M.P.H.). Since he is 50 minutes late, the train is normally 10 minutes from the crossing at that point. Therefore, the train will reach the crossing in 10 minutes.

173. (6009) It must be after 2000. The smallest digit for the thousand's place is 6. Then 9 must be in the unit's place. Place two zeros in between to get the next year after 1961.

174. ($7) Working backwards:

| Ken	10	14 (10 + 4)	7 ($\frac{1}{2}$ of 14)
Scott	8	4 ($\frac{1}{2}$ of 8)	11

175. (66,660)   Each digit appears 6 times in each of the 4 places. 6 (1+2+3+4) = 60. The unit's column will total 60. Put down 0 and carry the 6. The ten's column will total 60 + 6. Put down 6 and carry 6. The same for the hundred's and thousand's column.

176. (3) $82 - 28 = 56.$ $56 \div 2 = 28.$ 28 will have to be the total of the differences between these pairs of numbers. Interchange 1 and 15 (difference of 14); interchange 2 and 14 (difference of 12); interchange 7 and 9 (difference of 2). The sums on either side of 8 are now the same, namely 56.

177. (a = 5, b = 2) 3 + 4 + 5 = 12; 5 + 12 + 13 = 30. The lowest common multiple of 12 and 30 is 60. 60 = 5 x 12 and 60 = 2 x 30. Therefore, a = 5, 15 + 20 + 25 = 60; and b = 2, 10 + 24 + 26 = 60.

178. (32 M.P.H.) The car travelled 18 + 126 = 144 steps while the man took 18 steps. 144 ÷ 18 = 8. The car travelled 8 times as fast as the man is walking. 8 x 4 = 32 M.P.H.

179. ($1216) The triangles formed are isoceles right triangles. The base = 36, half the base = 18 and, there-fore, the altitude = 18. The area of the walk is the area of the garden minus the area of the 4 right triangles. 40 x 40 = 1600. $4 \left(\frac{1}{2} \cdot 36 \cdot 18 \right) = 1296$. 1600 − 1296 = 304. Cost = 304 x $4 = $1216.
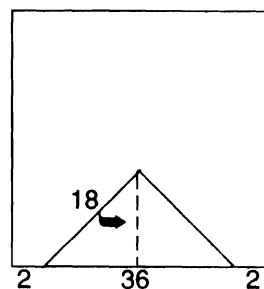
180. (45 M.P.H.) At the point of passing, car A has traveled $\frac{30}{20}$ or $1\frac{1}{2}$ times as fast as car B and $1\frac{1}{2}$ times the distance. Since the distances are reversed from this point, car B must travel $1\frac{1}{2}$ times as fast as car A. 30 x 1.5 = 45 M.P.H.

181. (.1 foot) Let h = new height of water. V = base area x height. 6h = 6x.5+1xh. 5h = 3; $h = \frac{3}{5} = .6$. .6 − .5 = .1 . Since .6 = new height, the water rose .1 foot.

182. (23) $5 + 7 + 11 = 23$. While $3 + 5 + 11 = 19$, the sides of a triangle could not be 3, 5, 11 since $11 > 3 + 5$. (2, 2, 3 is not scalene.)

183. (165)   Sixty cars (20% of 300) turned onto Ⓑ and 75 cars (25% of 300) turned onto Ⓒ. $60 + 75 = 135$; $300 - 135 = 165$. <u>Or</u> 55% of 300 = 165.

184. (2)   Joe jogs 2 miles $(1.5 + .5)$ in 30 minutes, or 4 m.p.h. The neighbor jogs 2 miles in 20 minutes, or 6 m.p.h. $6 - 4 = 2$.

185. ($1\frac{1}{2}$ minutes or 90 seconds)   Julie goes up the down escalator at the rate of 32 steps per minute (Julie's 96 steps/minute – escalator's 64 steps/minute). Since there are 48 steps from level to level, $48 \div 32 = 1\frac{1}{2}$ minutes.

186. (100)   All the palindromes between 10,000 and 20,000 must be of the form 1ABA1. Since there are 10 choices for "A" and 10 choices for "B", there are 100 palindromes between 10,000 and 20,000.

187. (25)   The total number of baseball cards is 32 (16 + 16). Working backwards:

Al	Bob		Al	Bob	
16	16	implies	8	24	after 3rd game
8	24	implies	4	28	after 2nd game
4	28	implies	18	14	after 1st game
18	14	implies	25	7	before 1st game

188. (16) $120 + 217 + 143 = 480$. $480 \div 3 = 160$. $180 - 160 = 20$. 80% of 20 = 16.
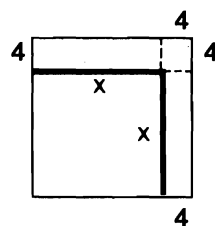
189. (400)   The additional 176 square feet is:

$4x + 4x + 16 = 176$

$8x = 160$

$x = 20$.

The original square field contains

$20 \times 20 = 400$ square feet.

190. (62)   Since the number sought has a remainder of 2 when divided by 3, 4 or 5, two less than the number would be the smallest positive integer divisible by 3, 4 or 5. $3 \times 4 \times 5 + 2 = 62$.

191. (3)   The perfect square numbers which are factors of 1125 are 3×3, 5×5, and $3^2 \times 5^2$.

192. ($32\frac{1}{2}$ or 32 minutes 30 seconds) $\frac{1}{5}$ of $2\frac{1}{2}$ miles = $\frac{1}{2}$ mile. At 12 m.p.h. it would take 5 minutes to travel one mile, or $2\frac{1}{2}$ minutes to travel the $\frac{1}{2}$ mile. His walking rate is slowed by $\frac{1}{3}$, so his walking rate is now $\frac{2}{3}$ (6) = 4 m.p.h. It would take 30 minutes to walk the 2 miles with his bike. 30 minutes + $2\frac{1}{2}$ minutes = $32\frac{1}{2}$ minutes.

193. (5) The students who will be out of the room are those whose tag number has an odd number of factors. Only perfect squares have an odd number of factors. The 5 students out of the room are those whose tag numbers are 1, 4, 9, 16 and 25.

194. (80)

$= 17 \times 5 - 5 = 80.$

195. (50) The arrival home 20 minutes earlier than usual is attributable to his walking. (If he had waited at the station, he would have arrived home at the regular time.) For the 20 minutes saved (all of which was driving time), half of that driving time, 10 minutes, he was still walking. (The time "out" for the car must equal the time "in".) He, therefore, walked for 50 minutes (60 minutes – 10 minutes in the car).

196. (Ross, 6) Atacus runs 475 yards to Ross' 500 yards. The ratio of their speeds is $\frac{475}{500}$ or $\frac{19}{20}$. For the 520 yards Ross will run in the 2nd race, Atacus will run $\frac{19}{20}$ (520) or $19 \times 26 = 494$ yards. Therefore, Ross will win by 6 yards.

197. (5100) Let A represent the required sum and let B represent the remaining numbers.

$$A = 4 + 8 + 12 + 16 + 20 + \ldots + 196 + 200$$
$$B = 2 + 6 + 10 + 14 + 18 + \ldots + 194 + 198 + 202$$
$$A - B = 2 + 2 + 2 + \ldots\ldots\ldots\ldots + 2 \quad - 202$$

50 times

$A + B = 10,302$ and $A - B = 100 - 202 = -102$.
Adding, $2A = 10,200$ and $A = 5100$.
Or: by pairing the first and the last, the second and next to last, etc.
$204 \times 25 = 5100$.

198. (b or $\frac{1}{3}$)   The present mix will make 9 pancakes (6 x $1\frac{1}{2}$). They must make 3 more pancakes so that each scout will have 2 pancakes. They must add $\frac{3}{9}$ or $\frac{1}{3}$ of the original amount to make 12 pancakes.

199. (24)   x + y = 10 and, since opposite sides of a rectangle are congruent, 3x = 2y. If y = $\frac{3}{2}$ x, then $\frac{5}{2}$ x = 10 and x = 4, y = 6. The area of the rectangular region labeled "A" is 6 x 4 = 24.

200. (35¢)   Hank must have an amount of money less than 18¢ which is a multiple of 4 (he has 4 times as much money as Steve). The only amounts which satisfy all the criteria are: Hank 16¢, Joe 10¢, Al 5¢, Steve 4¢.   16 + 10 + 5 + 4 = 35¢.

201. (16)   George can make any amount from 5¢ to 80¢ that is a multiple of 5.

202. (16)   If A0B – BA results in a two-digit number (since A0B – BA = BA – AB), then A must equal 1. Since $\begin{array}{r} 10B \\ -B1 \end{array}$ and $\begin{array}{r} B1 \\ -1B \end{array}$ give the same result, then the unit's digit must be the same. For B – 1 and 1 – B to have the same unit's digit, B must be 6. AB = 16.   (61 – 16 = 45; 106 – 61 = 45.)

203. (Donna <u>red</u>; Reneé <u>green</u>; Lisa <u>blue</u>)
     Donna cannot be on Reneé's right so Lisa
     must be.
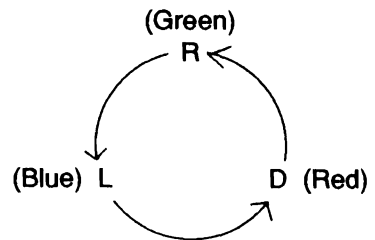
204. (3)   Ray paid $K. Bill parked $3\frac{1}{2}$ hours. Bill paid $K for the first hour and ($\frac{2}{3}$ K) (3) or $2K for the remaining $2\frac{1}{2}$ hours. Bill paid a total of $3K, or 3 times what Ray paid.

205.   (25)   Ann's 30 minutes + 20 minutes = 50 minutes. They meet $\frac{3}{5}$ of the distance from point A to point B. Therefore, it took Betty 30 minutes to travel $\frac{2}{5}$ of the distance from point B to point A. To travel the entire distance will take Betty 75 minutes $(30 \times \frac{5}{2})$. Since Ann's total time was 50 minutes, Betty will arrive at point A 25 minutes after Ann reaches point B.

206.   (4π)   Since $< O = < B$, $< O = 40°$. The area of a circle whose radius is 6 is 36π. The shaded region of the circle is $\frac{1}{9}$ of the circle ($40°$ is $\frac{1}{9}$ of $360°$). Therefore, the area of the shaded region is $\frac{1}{9}$ of 36π or 4π.

207.   (35)   A's food must have been 3 miles away while B's food was 4 miles away. Traveling at 3 m.p.h., A would reach B's food in $1\frac{1}{3}$ hours or 80 minutes, while B would reach A's food in $\frac{3}{4}$ hour or 45 minutes. $80 - 45 = 35$.

208.   (12 or 12 ft./sec.)   To run 12 feet, Al would take 3 seconds, Beth would take 2 seconds and Chuck would take 4 seconds. In a 24 foot race, Al and Beth would take 5 seconds. Since Chuck took 4 seconds to run the first half, Diane must run the remaining 12 feet in one second in order to tie. (For any other distances, times would be multiplied by a constant factor.)

209.   (A: 80 ft./sec.)   "A" gains 600 feet on "B" in 15 seconds. Therefore, "A" travels
        (B: 40 ft./sec.)   40 ft./sec. faster than "B". "A" and "B" travel a combined distance of 600 feet in 5 seconds. They have combined speeds of $\frac{600}{5} = 120$ ft./sec. "A" travels at 80 ft./sec. and "B" at 40 ft./sec.

210.   (160" or 13' 4")   Let x be depth now. $4x$ = finished depth. $4x = 70 + 3(70 - x)$; $4x = 70 + 210 - 3x$; $7x = 280$; $x = 40$. $4 \times 40 = 160"$.

211.   (Tom) Going backwards: one marble left is a losing position; 2 or 3 is a winning position; 4 is losing; 5 or 6 winning; 7 is losing.