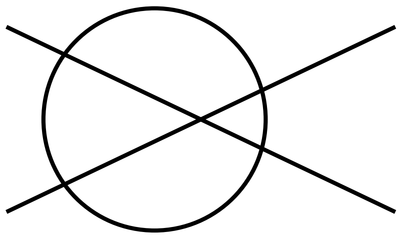
- A circle and two distinct lines are drawn on a sheet of paper. What is the largest possible number of points of intersection of these figures?

(A) 2 **(B)** 3 **(C)** 4 **(D)** 5 **(E)** 6

2002 AMC 8, Problem #1—"Draw some figures"

- **Solution (D)** Two distinct lines can intersect in one point whereas a line can intersect a circle in two points. The maximum number 5 can be achieved if the lines and circle are arranged as shown. Note that the lines could also meet outside the circle for the same result. (Other arrangements of the lines and circle can produce 0, 1, 2, 3, or 4 points of intersection.)



Difficulty: Easy

NCTM Standard: 6-8: Geometry: Use visualization, spatial reasoning, and geometric modeling to solve problems, draw geometric objects with specified properties, such as side lengths or angle measures.

Mathworld.com Classification:
Geometry > Line Geometry > Lines > Circle-Line Intersection;
Geometry > Plane Geometry > Circles > Circle-Line Intersection

- How many different combinations of \$5 bills and \$2 bills can be used to make a total of \$17? Order does not matter in this problem.

(A) 2 **(B)** 3 **(C)** 4 **(D)** 5 **(E)** 6

2002 AMC 8, Problem #2—"Can the number of \$5 bills be even?"

- **Solution (A)** Since the total \$17 is odd, there must be an odd number of \$5 bills. One \$5 bill plus six \$2 bills is a solution, as is three \$5 bills plus one \$2 bill. Five \$5 bills exceeds \$17, so these are the only two combinations that work.

Difficulty: Medium-easy

NCTM Standard: Problem Solving Standard for Grades 6–8: Apply and adapt a variety of appropriate strategies to solve problems.

Mathworld.com Classification:
Number Theory > Diophantine Equations > Diophantine Equation

- What is the smallest possible average of four distinct positive even integers?

(A) 3 **(B)** 4 **(C)** 5 **(D)** 6 **(E)** 7

2002 AMC 8, Problem #3—"What are the smallest four such numbers?"

- **Solution (C)** The smallest average will occur when the numbers are as small as possible. The four smallest distinct positive even integers are 2, 4, 6, and 8 and their average is 5.

Difficulty: Medium

NCTM Standard: Data Analysis and Probability Standard for Grades 6–8: Find, use, and interpret measures of center and spread, including mean and interquartile range.

Mathworld.com Classification:
Calculus and Analysis > Special Functions > Means > Arithmetic Mean

- The year 2002 is a palindrome (a number that reads the same from left to right as it does from right to left). What is the product of the digits of the next year after 2002 that is a palindrome?

(A) 0 **(B)** 4 **(C)** 9 **(D)** 16 **(E)** 25

2002 AMC 8, Problem #4—"A change in the tens digit means a change in the hundreds digit"

- **Solution (B)** The next palindrome is 2112. The product of its digits is $2 \cdot 1 \cdot 1 \cdot 2 = 4$.

Difficulty: Medium

NCTM Standard: Problem Solving Standard for Grades 6–8: Apply and adapt a variety of appropriate strategies to solve problems.

Mathworld.com Classification:
Number Theory > Special Numbers > Palindromic Numbers > Palindromic Number

- Carlos Montado was born on Saturday, November 9, 2002. On what day of the week will Carlos be 706 days old?

(A) Monday **(B)** Wednesday **(C)** Friday **(D)** Saturday **(E)** Sunday

2002 AMC 8, Problem #5—"How many complete weeks will have gone by?"

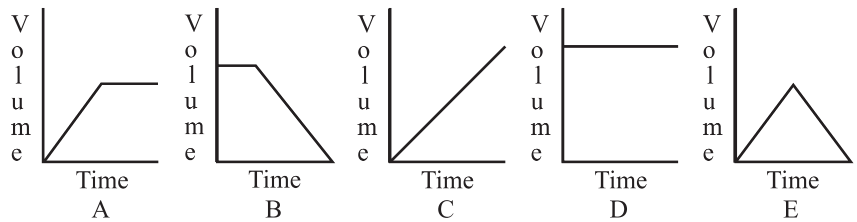
- **Solution (C)** Since 706 days is 700 plus 6 days, it is 100 weeks plus 6 days. Friday is 6 days after Saturday.

Difficulty: Medium-hard

NCTM Standard: Problem Solving Standard for Grades 6–8: Apply and adapt a variety of appropriate strategies to solve problems.

Mathworld.com Classification:
Number Theory > Congruences > Congruence

- A birdbath is designed to overflow so that it will be self-cleaning. Water flows in at the rate of 20 milliliters per minute and drains at the rate of 18 milliliters per minute. One of these graphs shows the volume of water in the birdbath during the filling time and continuing into the overflow time. Which one is it?



(A) A **(B)** B **(C)** C **(D)** D **(E)** E

2002 AMC 8, Problem #6— "What happens initially? Which graphs show this?"

- **Solution**

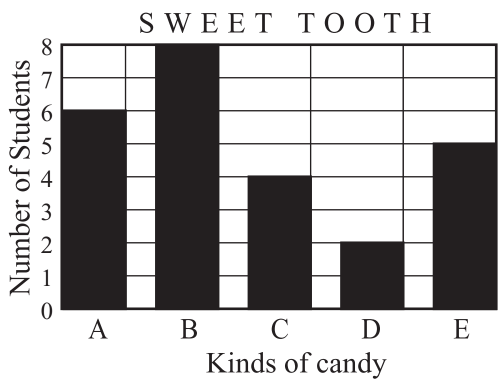
  (A) Initially, volume increases with time as shown by graphs A, C, and E. But once the birdbath is full, the volume remains constant as the birdbath overflows. Only graph A shows both features.

Difficulty: Medium-hard

NCTM Standard: Data Analysis and Probability Standard: Develop and evaluate inferences and predictions that are based on data

Mathworld.com Classification: Discrete Mathematics > Graph Theory > General Graph Theory > Graph

- The students in Mrs. Sawyer's class were asked to do a taste test of five kinds of candy. Each student chose one kind of candy. A bar graph of their preferences is shown. What percent of her class chose candy E?



(A) 5 **(B)** 12 **(C)** 15 **(D)** 16 **(E)** 20

2002 AMC 8, Problem #7— "How many students are there?"

- **Solution**

(E) There are $6+8+4+2+5=25$ students. Of the 25 students 5 prefer candy E and $\frac{5}{25}=\frac{20}{100}=20\%$.

Difficulty: Medium-easy
NCTM Standard: Number and Operations Standard: Understand meanings of operations and how they relate to one another
Mathworld.com Classification: Number Theory > Arithmetic > Fractions > Percent

Juan's Old Stamping Grounds

Juan organizes the stamps in his collection by country and by the decade in which they were issued. The prices he paid for them at a stamp shop were: Brazil and France, 6¢ each, Peru 4¢ each, and Spain 5¢ each. (Brazil and Peru are South American countries and France and Spain are in Europe.)

Number of Stamps by Decade

Country	‘50s	‘60s	‘70s	‘80s
Brazil	4	7	12	8
France	8	4	12	15
Peru	6	4	6	10
Spain	3	9	13	9

Juan's Stamp Collection

How many of his European stamps were issued in the '80s?

(A) 9 **(B)** 15 **(C)** 18 **(D)** 24 **(E)** 42

2002 AMC 8, Problem #8— "How many French and Spanish stamps were issued then?"

- **Solution**

(D) There are 15 French stamps and 9 Spanish stamps issued in the ‘80s. So there are $15 + 9 = 24$ European stamps listed in the table in the ‘80s.

Difficulty: Easy

NCTM Standard: Data Analysis and Probability Standard: Develop and evaluate inferences and predictions that are based on data

Mathworld.com Classification: Discrete Mathematics > Computer Science > Data Structures > Database

Juan's Old Stamping Grounds

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Peru	6	4	6	10
Spain	3	9	13	9

Juan's Stamp Collection

His South American stamps issued before the '70s cost him

(A) \$0.40 **(B)** \$1.06 **(C)** \$1.80 **(D)** \$2.38 **(E)** \$2.64

2002 AMC 8, Problem #9— "How many from Brazil and Peru?"

- **Solution**

(B) His South American stamps issued before the '70s include $4+7=11$ from Brazil that cost $11\times\$0.06=\$0.66$ and $6+4=10$ from Peru that cost $10\times\$0.04=\$0.40$. Their total cost is $\$0.66+\$0.40=\$1.06$.

Difficulty: Medium-easy

NCTM Standard: Data Analysis and Probability Standard: Develop and evaluate inferences and predictions that are based on data

Mathworld.com Classification: Discrete Mathematics > Computer Science > Data Structures > Database

Juan's Old Stamping Grounds

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Spain	3	9	13	9

Juan's Stamp Collection

The average price of his '70s stamps is closest to

(A) 3.5¢ **(B)** 4¢ **(C)** 4.5¢ **(D)** 5¢ **(E)** 5.5¢

2002 AMC 8, Problem #10— "How much did he spend on '70s stamps in each country?"

- **Solution**

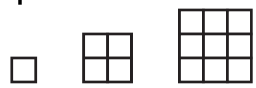
(E) The '70s stamps cost: Brazil, $12(\$0.06) = \$0.72$; Peru, $6(\$0.04) = \$0.24$; France, $12(\$0.06) = \$0.72$; Spain, $13(\$0.05) = \$0.65$. The total is \$2.33 for the 43 stamps and the average price is $\frac{\$2.33}{43} \approx$ \$0.054 $\approx$ 5.5¢.

Difficulty: Medium

NCTM Standard: Data Analysis and Probability Standard: Develop and evaluate inferences and predictions that are based on data

Mathworld.com Classification: Discrete Mathematics > Computer Science > Data Structures > Database

- A sequence of squares is made of identical square tiles. The edge of each square is one tile length longer than the edge of the previous square. The first three squares are shown. How many more tiles does the seventh square require than the sixth?



(A) 11 **(B)** 12 **(C)** 13 **(D)** 14 **(E)** 15

2002 AMC 8, Problem #11—"Consider the areas of the figures"

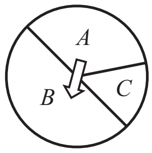
- **Solution (C)** The number of additional tiles needed is $7^2 - 6^2 = 49 - 36 = 13$.

Difficulty: Medium-easy

NCTM Standard: Algebra Standard for Grades 6–8: Represent, analyze, and generalize a variety of patterns with tables, graphs, words, and, when possible, symbolic rules.

Mathworld.com Classification:
Number Theory > Special Numbers > Figurate Numbers > Square Numbers

- A board game spinner is divided into three regions labeled A, B and C. The probability of the arrow stopping on region A is $\frac{1}{3}$ and on region B is $\frac{1}{2}$. The probability of the arrow stopping on region C is



(A) $\frac{1}{12}$ **(B)** $\frac{1}{6}$ **(C)** $\frac{1}{5}$ **(D)** $\frac{1}{3}$ **(E)** $\frac{2}{5}$

2002 AMC 8, Problem #12—"Use the probability of the complement"

- **Solution (B)** Since the sum of the three probabilities is 1, the probability of stopping on region C is $1 - \frac{1}{3} - \frac{1}{2} = \frac{6}{6} - \frac{2}{6} - \frac{3}{6} = \frac{1}{6}$.

Difficulty: Medium-easy

NCTM Standard: Data Analysis and Probability Standard for Grades 6–8: Understand and use appropriate terminology to describe complementary and mutually exclusive events.

Mathworld.com Classification:
Probability and Statistics > Probability > Probability

- For his birthday, Bert gets a box that holds 125 jellybeans when filled to capacity. A few weeks later, Carrie gets a larger box full of jellybeans. Her box is twice as high, twice as wide and twice as long as Bert's. Approximately, how many jellybeans did Carrie get?

(A) 250 **(B)** 500 **(C)** 625 **(D)** 750 **(E)** 1000

2002 AMC 8, Problem #13—"Compare the volumes of the boxes"

- **Solution (E)** Since the exact dimensions of Bert's box do not matter, assume the box is $1 \times 2 \times 3$. Its volume is 6. Carrie's box is $2 \times 4 \times 6$, so its volume is 48 or 8 times the volume of Bert's box. Carrie has approximately $8(125) = 1000$ jellybeans.
  Note: Other examples may help to see that the ratio is always 8 to 1.

Difficulty: Medium-hard

NCTM Standard: Geometry Standard for Grades 6–8: Understand relationships among the angles, side lengths, perimeters, areas, and volumes of similar objects.

Mathworld.com Classification:
Geometry > Solid Geometry > Volume > Volume

- A merchant offers a large group of items at 30% off. Later, the merchant takes 20% off these sale prices and claims that the final price of these items is 50% off the original price. The total discount is actually

(A) 35% **(B)** 44% **(C)** 50% **(D)** 56% **(E)** 60%

2002 AMC 8, Problem #14—"What percent of the price does a customer pay after each discount?"

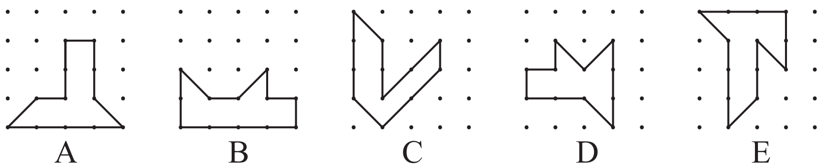
- **Solution (B)** The first discount means that the customer will pay 70% of the original price. The second discount means a selling price of 80% of the discounted price. Because $0.80(0.70) = 0.56 = 56\%$, the customer pays 56% of the original price and thus receives a 44% discount.

Difficulty: Hard

NCTM Standard: Number and Operations Standard for Grades 6–8: Work flexibly with fractions, decimals, and percents to solve problems.

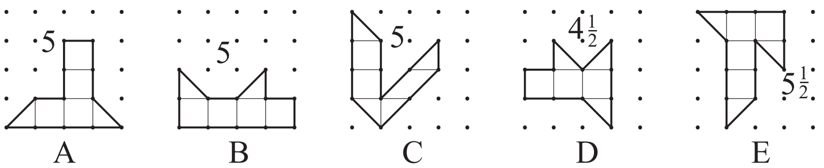
Mathworld.com Classification:
Number Theory > Arithmetic > Fractions > Percent

- Which of the following polygons has the largest area?



2002 AMC 8, Problem #15— "Divide in triangles and squares"

- **Solution (E)** Areas may be found by dividing each polygon into triangles and squares as shown.



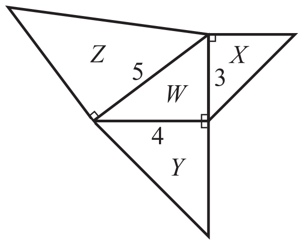
Note: Pick's Theorem may be used to find areas of geoboard polygons. If I is the number of dots inside the figure, B is the number of dots on the boundary and A is the area, then $A = I + \frac{B}{2} - 1$. Geoboard figures in this problem have no interior points, so the formula simplifies to $A = \frac{B}{2} - 1$. For example, in polygon D the number of boundary points is 11 and $\frac{11}{2} - 1 = 4\frac{1}{2}$.

Difficulty: Easy

NCTM Standard: Grades 6-8 Geometry: Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships. Middle-grades students should explore a variety of geometric shapes and examine their characteristics. Students can conduct these explorations using materials such as geoboards, dot paper, ...

Mathworld.com Classification:
Discrete Mathematics > Combinatorics > Lattice Paths and Polygons > Lattice Polygons > Pick's Theorem;
Geometry > Computational Geometry > Triangulation > Triangulation

- Right isosceles triangles are constructed on the sides of a 3-4-5 right triangle, as shown. A capital letter represents the area of each triangle. Which one of the following is true?



(A) $X + Z = W + Y$ **(B)** $W + X = Z$ **(C)** $3X + 4Y = 5Z$
(D) $X + W = \frac{1}{2}(Y + Z)$ **(E)** $X + Y = Z$

2002 AMC 8, Number #16— "A variant of the Pythagorean Theorem"

- **Solution (E)** The areas are $W = \frac{1}{2}(3)(4) = 6$, $X = \frac{1}{2}(3)(3) = 4\frac{1}{2}$, $Y = \frac{1}{2}(4)(4) = 8$ and $Z = \frac{1}{2}(5)(5) = 12\frac{1}{2}$. Therefore, (E) is correct. $X + Y = 4\frac{1}{2} + 8 = 12\frac{1}{2} = Z$. The other choices are incorrect.

OR

By the Pythagorean Theorem, if squares are constructed on each side of any right triangle, the sum of the areas of the squares on the legs equal the area of the square on the hypotenuse. So $2X + 2Y = 2Z$, and $X + Y = Z$.

Difficulty: Hard

NCTM Standard: Grades 6-8 Geometry: Use visualization, spatial reasoning, and geometric modeling to solve problems. ...Eighth graders should be familiar with one of the many visual demonstrations of the Pythagorean relationship, the diagram showing three squares attached to the sides of a right triangle.

Mathworld.com Classification:
Geometry > Plane Geometry > Triangles > Special Triangles > Other Triangles > Right Triangles

- In a mathematics contest with ten problems, a student gains 5 points for a correct answer and loses 2 points for an incorrect answer. If Olivia answered every problem and her score was 29, how many correct answers did she have?

(A) 5 **(B)** 6 **(C)** 7 **(D)** 8 **(E)** 9

2002 AMC 8, Problem #17—"Try to guess and check

- **Solution (C)** Olivia solved at least 6 correctly to have scored over 25. Her score for six correct would be $6(+5) + 4(-2) = 22$, which is too low. If she answered 7 correctly, her score would be $7(+5) + 3(-2) = 29$, and this was her score. The correct is choice (C).

Difficulty: Medium

NCTM Standard: Algebra Standard for Grades 6–8: Use symbolic algebra to represent situations and to solve problems, especially those that involve linear relationships.

Mathworld.com Classification:
Number Theory > Diophantine Equations > Diophantine Equation

- Gage skated 1 hr 15 min each day for 5 days and 1 hr 30 min each day for 3 days. How long would he have to skate the ninth day in order to average 85 minutes of skating each day for the entire time?

(A) 1 hr **(B)** 1 hr 10 min **(C)** 1 hr 20 min **(D)** 1 hr 40 min **(E)** 2 hr

2002 AMC 8, Problem #18—"Find the total number of minutes needed"

- **Solution (E)** In 5 days, Gage skated for $5 \times 75 = 375$ minutes, and in 3 days he skated for $3 \times 90 = 270$ minutes. So, in 8 days he skated for $375 + 270 = 645$ minutes. To average 85 minutes per day for 9 days he must skate $9 \times 85 = 765$ minutes, so he must skate $765 - 645 = 120$ minutes = 2 hours the ninth day.

Difficulty: Medium-hard

NCTM Standard: Data Analysis and Probability Standard for Grades 6–8: Find, use, and interpret measures of center and spread, including mean and interquartile range.

Mathworld.com Classification:
Calculus and Analysis > Special Functions > Means > Arithmetic Mean

- How many whole numbers between 99 and 999 contain exactly one 0?

(A) 72 **(B)** 90 **(C)** 144 **(D)** 162 **(E)** 180

2002 AMC 8, Problem #19—"How many choices for the place of the 0 and the values of the other digits?"

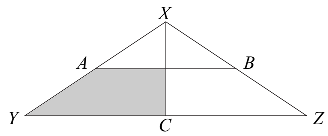
- **Solution (D)** Numbers with exactly one zero have the form _0_ or __0, where the blanks are not zeros. There are $(9{\cdot}1{\cdot}9)+(9{\cdot}9{\cdot}1) = 81+81 = 162$ such numbers.

Difficulty: Medium-hard

NCTM Standard: Problem Solving Standard for Grades 6–8: Apply and adapt a variety of appropriate strategies to solve problems.

Mathworld.com Classification:
Combinatorics > Enumeration

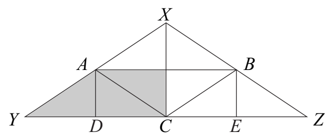
- The area of triangle XYZ is 8 square inches. Points A and B are mid points of congruent segments $\overline{XY}$ and $\overline{XZ}$. Altitude $\overline{XC}$ bisects $\overline{YZ}$. The area (in square inches) of the shaded region is



(A) $1\frac{1}{2}$ **(B)** 2 **(C)** $2\frac{1}{2}$ **(D)** 3 **(E)** $3\frac{1}{2}$

2002 AMC 8, Problem #20— "Divide into congruent triangles"

- **Solution (D)** Segments $\overline{AD}$ and $\overline{BE}$ are drawn perpendicular to $\overline{YZ}$. Segments $\overline{AB}$, $\overline{AC}$ and $\overline{BC}$ divide $\triangle XYZ$ into four congruent triangles. Vertical line segments $\overline{AD}$, $\overline{XC}$ and $\overline{BE}$ divide each of these in half. Three of the eight small triangles are shaded, or $\frac{3}{8}$ of $\triangle XYZ$. The shaded area is $\frac{3}{8}(8) = 3$.



OR

Segments $\overline{AB}$, $\overline{AC}$ and $\overline{BC}$ divide $\triangle XYZ$ into four congruent triangles, so the area of $\triangle XAB$ is one-fourth the area of $\triangle XYZ$. That makes the area of trapezoid $ABZY$ three-fourths the area of $\triangle XYZ$. The shaded area is one-half the area of trapezoid $ABZY$, or three-eighths the area of $\triangle XYZ$, and $\frac{3}{8}(8) = 3$.

Difficulty: Medium-hard

NCTM Standard: Grades 6-8 Geometry : Use visualization, spatial reasoning, and geometric modeling to solve problems. Apply transformations and use symmetry to analyze mathematical situations describe sizes, positions, and orientations of shapes under informal transformations such as flips, turns, slides, and scaling; examine the congruence, similarity, and line or rotational symmetry of objects using transformations.

Mathworld.com Classification:

Geometry > Plane Geometry > Geometric Similarity > Congruent

- Harold tosses a nickel four times. The probability that he gets at least as many heads as tails is

(A) $\frac{5}{16}$ **(B)** $\frac{3}{8}$ **(C)** $\frac{1}{2}$ **(D)** $\frac{5}{8}$ **(E)** $\frac{11}{16}$

2002 AMC 8, Problem #21— "Carefully enumerate all possibilities"

- **Solution (E)** There are 16 possible outcomes: $HHHH$, $HHHT$, $HHTH$, $HTHH$, $THHH$, $HHTT$, $HTHT$, $HTTH$, $THTH$, $THHT$, $TTHH$ and $HTTT$, $THTT$, $TTHT$, $TTTH$, $TTTT$. The first eleven have at least as many heads as tails. The probability is $\frac{11}{16}$.

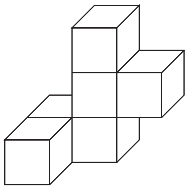
Difficulty: Hard

NCTM Standard: Understand and apply basic concepts of probability, compute probabilities for simple compound events, using such methods as organized lists, tree diagrams, and area models.

Mathworld.com Classification:

Probability and Statistics > Probability > Coin Tossing

- Six cubes, each an inch on an edge, are fastened together, as shown. Find the total surface area in square inches. Include the top, bottom and sides.



(A) 18 **(B)** 24 **(C)** 26 **(D)** 30 **(E)** 36

2002 AMC 8, Problem #22— "Subtract hidden faces from all faces"

- **Solution (C)** Before the cubes were glued together, there were $6 \times 6 = 36$ faces exposed. Five pairs of faces were glued together, so $5 \times 2 = 10$ faces were no longer exposed. This leaves $36 - 10 = 26$ exposed faces.

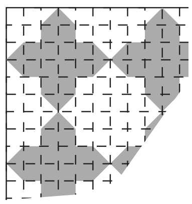
Difficulty: Hard

NCTM Standard: Use visualization, spatial reasoning, and geometric modeling to solve problems; use two-dimensional representations of three-dimensional objects to visualize and solve problems such as those involving surface area and volume.

Mathworld.com Classification:

Geometry > Solid Geometry > Polyhedra > Cubes > Polycubes

- A corner of a tiled floor is shown. If the entire floor is tiled in this way and each of the four corners looks like this one, then what fraction of the tiled floor is made of darker tiles?

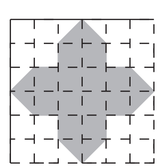


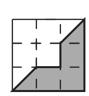
(A) $\frac{1}{3}$ **(B)** $\frac{4}{9}$ **(C)** $\frac{1}{2}$ **(D)** $\frac{5}{9}$ **(E)** $\frac{5}{8}$

2002 AMC 8, Problem #23— "The 6×6 square in the upper left-hand region is tessellated, so finding the proportion of darker tiles in this region will answer the question."

- **Solution**

  (B) The 6×6 square in the upper left-hand region is tessellated, so finding the proportion of darker tiles in this region will answer the question. The top left-hand corner of this region is a 3×3 square that has $3 + 2\left(\frac{1}{2}\right) = 4$ darker tiles. So $\frac{4}{9}$ of the total area will be made of darker tiles.





Difficulty: Medium-hard
NCTM Standard: Geometry Standard: Use visualization, spatial reasoning, and geometric modeling to solve problems
Mathworld.com Classification: Geometry > Plane Geometry > Tiling > Recreational Mathematics > Tiling

- Miki has a dozen oranges of the same size and a dozen pears of the same size. Miki uses her juicer to extract 8 ounces of pear juice from 3 pears and 8 ounces of orange juice from 2 oranges. She makes a pear-orange juice blend from an equal number of pears and oranges. What percent of the blend is pear juice?

(A) 30 **(B)** 40 **(C)** 50 **(D)** 60 **(E)** 70

2002 AMC 8, Problem #24—"Use a multiple of 3 pears which equals a multiple of 2 oranges"

- **Solution (B)** Use 6 pears to make 16 oz of pear juice and 6 oranges to make 24 oz of orange juice for a total of 40 oz of juice. The percent of pear juice is $\frac{16}{40} = \frac{4}{10} = 40\%$.

Difficulty: Medium-hard

NCTM Standard: Number and Operations Standard for Grades 6–8: Understand and use ratios and proportions to represent quantitative relationships.

Mathworld.com Classification:
Number Theory > Arithmetic > Fractions > Percent

- Loki, Moe, Nick and Ott are good friends. Ott had no money, but the others did. Moe gave Ott one-fifth of his money, Loki gave Ott one-fourth of his money and Nick gave Ott one-third of his money. Each gave Ott the same amount of money. What fractional part of the group's money does Ott now have?

(A) $\frac{1}{10}$ **(B)** $\frac{1}{4}$ **(C)** $\frac{1}{3}$ **(D)** $\frac{2}{5}$ **(E)** $\frac{1}{2}$

2002 AMC 8, Problem #25— "Make the numbers easy"

- **Solution (B)** Only the fraction of each friend's money is important, so we can assume any convenient amount is given to Ott. Suppose that each friend gave Ott \$1. If this is so, then Moe had \$5 originally and now has \$4, Loki had \$ 4 and now has \$3, and Nick had \$3, and now has \$2. The four friends now have $\$4 + \$3 + \$2 + \$3 = \$12$, so Ott has $\frac{3}{12} = \frac{1}{4}$ of the group's money. This same reasoning applies to any amount of money.

Difficulty: Hard

NCTM Standard: Grades 6-8 Problem Solving: Instructional programs from prekindergarten through grade 12 should enable all students to solve problems that arise in mathematics and in other contexts; apply and adapt a variety of appropriate strategies to solve problems;

Mathworld.com Classification:

Number Theory > Arithmetic > Fractions > Fraction